ENGINEERING NEWS

THE REPORT OF THE BOARD OF ENGINEERS on plans for the Quaker Bridge dam, consisting of Messrs. JOSEPH P. DAVIS, J. J. R. CROES and WM. F. SHUNK, who were appointed in March last, was rendered this week to the Aqueduct Commission. The full report has not yet been made public, but it is adverse to the plans prepared by the aqueduct engineers.

They recommend a curved plan with a radius of 1,146 ft. considering that a wall so constructed would offer greater resistance than any other to the ordinary pressure put upon it, as well as to the extraordinary strain caused by freshets or ice. Besides this feature the long curved wall could be made more effective in an architectural sense than any other. What the recommendations were in regard to the section or profile of the dam, which seemed to us likewise to need revision, we are not yet advised. So far as the plan of the dam is concerned, the report is exactly in accordance, with the views expressed by this journal just before the Board was appointed.

VALPARAISO, Chili, was the scene of a terrible catastrophe on Aug. 11, occasioned by the bursting of the Mena earthen reservoir, about 900 ft. above the level of the sea. The reservoir was formed in the simplest manner possible, of earth only, and its reported dimensions were 50 m. in length, 17 m. in height, 40 m. thick at the base, and 15 m. thick at at the top. These dimensions, however, give only a 1 to 1 slope, from which the conclusion must be either that the dimensions are wrong, or that the slopes were, at least in part, faced with a rock wall.

The embankment gave way suddenly, and the water rushed down the ravine with resistless force, sweeping away houses and human beings, and inundating a large area of the city with a sea of liquid mud. There was no warning of any kind. The stream, as it rushed down the Yungai river, carried with it human beings, houses, trees, furniture, boulders, etc., in one confused mass. As usually happens in such cases, the head of the flood appeared like a gigantic wall of water from 15 to 20 ft. in height.

Over 50 bodies were recovered the following morning, while many were injured. The damage is estimated at nearly $3,000,000.

THE high trestle at Buffalo Hollow, on the Kentucky Midland R. R. will shortly be completed, and it is stated will be the highest wooden trestle in the world. We do not know its exact height.

A SPECIAL TRAIN over the Montana Central, which is an extension of the Manitoba system in Montana, is said to have made the remarkable time of 72 miles in one hour over the new line. When this remarkable time was made, the party was at breakfast, but suffered no inconvenience. The road is a new one and crosses the main range of the Rocky Mountains between Butte and Helena. It is laid with oak ties, 3,000 to the mile, and has 75 lb. steel rails.

IT is reported from London that arrangements are nearly completed for the experiment which is to be tried of adopting electric locomotives on the underground railway there. The experiment, though it is on a rather large scale, will not in all respects conform with the conditions of the actual service, for the locomotive, which is to be put on in October will draw with it storage batteries capable of developing the power necessary for a 28 mile run. This involves carrying 100 tons of lead along with the train, and will, of course, be an expensive operation. The permanent service will probably be obtained from fixed conductors of copper wire strung overhead through the tunnel, but the expense of placing this was considered too great to be incurred until the experiment should first be tried.

The first locomotive to be put on the road will be 600 H. P., and will be provided with three independent motors, any two of which will be able to carry the train out of the city in case one shall break down. This precaution was deemed necessary in order to avoid any possibility of choking the great current of travel that constantly passes over the road, when trains follow one another at intervals of only 3 minutes.

THE STATEN ISLAND RAPID TRANSIT RAILROAD CO. have completed plans for a new ferry house, to be erected at the foot of Whitehall St., New York. The structure will have a frontage of 185 ft. and will be in two stories. The waiting-room in the center will be 61 ft. wide by 92 ft. long. The passageway for teams is 15 ft. wide and for passengers 11⅔ ft. Separating the two slips is a two-story pavilion forming a continuation of the main building. The width of the pavilion decreases from 38 ft. at the point where it joins the main building to 20 ft. at its outer end. The second floor, the entrance to which is to the left of the main entrance, connects with the elevated railroad platform. The second story of the ferry-house will be used for general offices. The building was designed by R. J. HAXBY, the architect.

THE cove basin controversy in Providence is at last over. The application for an injunction to restrain the city from filling the basin in accordance with the plans for the improvement of railway terminal facilities has been denied by the Supreme Court, and there is now no bar to the immediate prosecution of the work of filling the cove. The contractor for the work has already made a beginning, as he was required to do within 30 days after the conclusion of the contract.

PUBLIC WORKS PLANNED IN PHILADELPHIA.—The talk about a bridge across the Schuylkill river at Walnut St. in Philadelphia is being renewed. The scheme is very much in the air as yet, but $800,000 is talked of as the price and 1890 as the date of completion. Among the other items which will be included in the city budget if $1.85 can be fixed as the tax rate are—$100,000 for the Aramingo Canal improvement: $50,000 for the Mill Creek sewer; $350,000 for one of the sections of the East Park Reservoir and $400,000 for new school houses.

THE SAULT STE. MARIE CANAL has had a larger traffic this year even than last, which was the largest in its history. Between May 1 and Sept. 1 of this year, or 4 mos., the traffic passed had been 4,023,709 tons and 20,758 passengers. On Oct. 1 of last week its traffic for 5 mos. was already larger than for the 7 mos. of the preceding season of 7 mos. in which 9,355 vessels, 5,968 of them steamers, passed through the lock. In the year before, 1886, the traffic was 18,837 tons per day against 15,802 tons per day on the Suez canal. The opening of navigation has varied from April 8 to May 12, but is very rarely so late as May 1; the closing is usually after Dec. 2. The new lock will be 1,000 × 100 ft. The coffer dam for it will be finished this fall, and 1,500 men will be employed next year on the foundation. The total estimated cost of the new lock is $5,000,000 and 5 years will be required for its completion.

THE UNDERGROUND WIRES IN BROOKLYN seem to be giving trouble from corrosion, according to the statement of Mr WM. D. SARGENT, the Gen. Manager of the New Jersey Telephone Co. Chicago apparently has better luck, for the business section of that city is said to have 5,000 miles of underground wire in successful operation, including 16 miles of electric light wire. The secret out there seems to have been to allow each company to select its own type of conduit, but to compel the company to bury its wires somehow at once. These companies admit that while it costs nine times as much to put wires underground as it does to suspend them overhead, the saving in repairs by the reduction of the force of linemen more than makes up this first outlay.

PROPOSED ARGENTINE RAILWAYS. — The *Buenos Ayres Herald* says the Argentine department of engineers has now before it for study the proposals for no less than 87 railways. Assuming the average length to be 600 kilometres, the aggregate length proposed to be constructed is 51,000 kilometres, and the aggregate cost would be about $1,275,000,000 gold, and the guaranteed interest at 5 per cent. would be $63,250,000 gold.

A NEW SWISS RAILWAY.—The London *Daily News* says that a railway is to be built from Visp, on the present Rhone Valley railway, to Zermatt, almost at the foot of the famous Matterhorn. It will be narrow-gauge, but without a rack rail or appliances of that nature. The curves will be sharp, and there will be 6 small tunnels and 5 bridges over the Visp torrent. The length will be 28 miles, and it will ascend 3,160 ft. above the starting points in this distance. It is estimated to cost $1,300,000 and is to be commenced this fall.

REPLENISHMENT OF UNDERGROUND WATERS.—Mr. G. BAILY DENTON, in a late paper read before the British Association, suggests the restoration to the permeable strata of any surplus water in the streams about London. He proposes that whenever the water in the Thames river rises above a certain level, the excess be diverted to filter beds which have an outlet by a tight shaft sunk to the underground water level. This would appear to be rather an expensive method of increasing a water supply.

RAILS IN GERMANY.—A contract has just been let at Carlsruhe for 13,500 tons of rails. Five of the German steel works tendered upon the occasion, their offers ranging from $23.68 to $23.76 per ton.

THE FIRST CHINESE RAILWAY CAR is illustrated in the last issue of *Le Genie Civil*, from a photograph. It belongs to the French railway of 3½ miles, soon to be completed and running between Tien-Tsin and the summer palace of the Chinese viceroy. It is apparently an exhibition line and it may be removed to the Imperial park at Pekin later. The road is about 2.6 ft. gauge, is laid with 30 lb. Vignoles rails and wooden ties. The engine is a tank locomotive with 4 wheels coupled. The car is a palace car about 37 ft. long with 8 wheels rigid, as usual in the larger Continental cars.

A SUBSTITUTE FOR GLASS.—London papers state that the Transparent Wire-Wove Roofing Co., of 164 Queen Victoria St., London, has introduced a new roofing and sky-light material, applicable also to many other uses for which glass is unsuited. The base is a web of fine iron wire with a 1-12 in. mesh. This is dipped edgewise in deep tanks of varnish until the requisite thickness is obtained. It is claimed that the product will stand heat, can be cut with scissors and nailed; it transmits light, being of a pleasing amber color and translucent, and can be used for many purposes, as it will bend like leather.

THE NUMBER OF RAILROAD ACCIDENTS during the past week has been unusually large. The most serious accident occurred on the Oregon Short Line (U. P. R. R.) on Sept. 27, and was caused by a freight train running into a herd of cattle, resulting in the death of three trainmen. On Oct. 1 a serious accident occurred on the Pennsylvania Railroad, near Newark, N. J., between a passenger train and a mixed freight train. The accident was caused by the air brakes refusing to work. Several were severely injured, and the damage is reported to amount to $30,000. On Oct. 1 a passenger train on the Wabash Western was thrown from the track near Mexico, Mo., by strikers. Several persons were injured and the damage was very large.

BRIDGE ACCIDENTS of the week have been reported as follows: An iron bridge which was to have been completed on Sept. 29, over the St. Francois river near Fredericktown, Mo., gave way under a freight train on the St. Louis, Iron Mountain & Southern Railway, on the same day, carrying seven loaded freight cars with it into a chasm 50 ft. below.——Sept. 30, a bridge over Wild Cat Creek, on the Columbus & Western Railroad, 60 miles south of Birmingham, Ala., gave way under a freight train. The engine and 16 cars fell a distance of 60 ft. Several men were injured, one fatally. Defective timbers caused the accident.——A highway bridge over Rock river, near Janesville, Wis., collapsed on Sept. 26.——High water has caused considerable damage during the past week in the vicinity of Eagle Pass, Tex., and the iron bridge of the Mexican International Railway is likely to be swept away. The Alapaha River, in Florida, is also reported to be doing a great deal of damage, and has carried away several small highway bridges.

Water Level and Rainfall of the Great Lakes.

The interesting diagrams which we extract by permission from a large diagram compiled by Mr. CHAS. CROSMAN of Milwaukee, Wis., containing much fuller information, sufficiently explain themselves without much comment. The primary purpose which led to the compilation of the information, as we understand it, was alarm lest the recent fall in the water level of the lakes, to which the diagrams bear witness, was due to some permanent cause, a new subterranean channel having even been suggested. All fears of this kind are dispelled by the chart, which likewise bears interesting testimony to the general regimen of the lakes. From the pamphlet accompanying the chart we extract the following:

A careful examination of the chart will show that from 1882 to 1888 the surface of Lakes Michigan, Huron and Erie was considerably above the mean level.

The water at the present time (spring of 1888) is about 1 ft. lower than the average of the period from 1882 to 1887, and, judging the future by the past, it is probable that for several years next ensuing there will be no permanent increase in depth.

During periods of high water, parties interested in navigation are happy, while owners of property on the lake shores are less jubilant as they witness the rapid erosion of the shore and disappearance of their real estate never more to return. Occupants of stores and warehouses are also subjected to much anxiety and not unfrequently to heavy losses by the flooding of basements and cellars. These losses may be materially lessened by taking the necessary precautionary measures.

Gen. O. M. POE, Lieut. Col. Engr's. U. S. A. states that—

"There is no indication anywhere that the waters in the lakes have mysteriously fallen. The long continued series of observations now available show that since 1838 the water level has fluctuated within limits somewhat less than 6 ft. and that these fluctuations were due to the greater or less rain and snow fall. It may be considered as a fact established that the lakes are simply great pools forming part of the course of a river, and that they conform to all the laws governing the rise and fall of rivers.

"The observations alluded to also show that there is practically no difference of level between the inlet and outlet of any one of the lakes. That is to say, that in a state of rest the surface of the water in each lake is level. But the surface is greatly affected by winds, variations in barometric pressure and other extraneous phenomena.

"The relation between the rainfall and the stage of the lake can be perceived unmistakably in the spring, autumn and summer of 1876, the remarkable rise of water, culminating in September, 1876, corresponding with a period of heavy rainfall. This period was followed by a few months of light rainfall, during which the water fell rapidly. From this time until December, 1879, the rainfall was, as a general thing, less than the mean, and the water's surface had a downward tendency.

"In January, 1880, began a period of heavy rainfall and a rise in the water. From June to August, 1881, the rainfall was light and the stage of water a falling one. In September there was the heaviest rainfall known for many years, accompanied by a correspondingly rapid rise in the water."

A paper by L. Y. SCHERMERHORN gives much interesting information on this subject as follows:

"In the following memoranda an attempt has been made to assemble a part of the latest and most reliable information relating to the Great Lakes. The lately completed lake surveys, made by the United States have reduced to exactness much that previously was only approximate and the perfection of meth ds used give a perfection to the results which seldom obtains in surveys covering so great geographical extent and involving so many details.

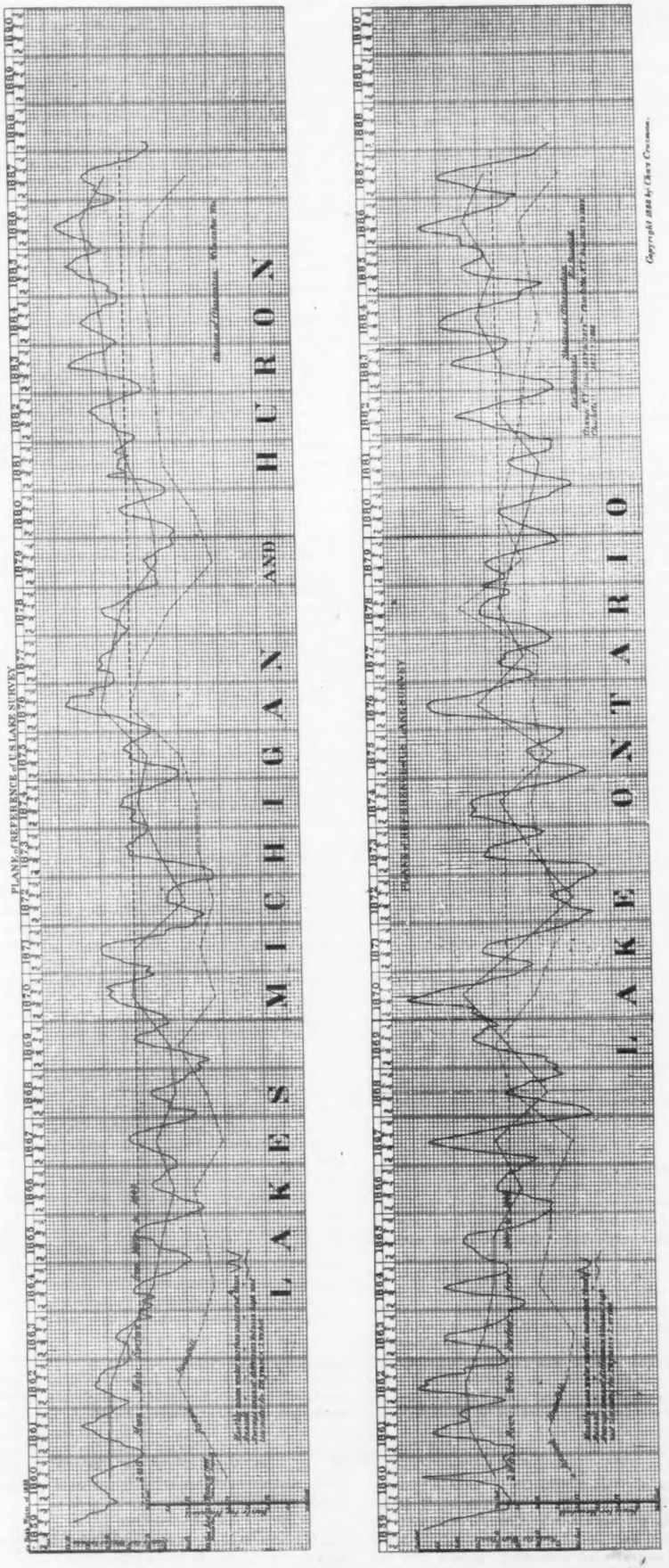
The water surface of the Great Lakes with the land draining into it presents a total drainage basin of over 270,000 sq. miles, assembled as follows:

	Area of Water Surface, Sq. Miles.	Area of Water-Shed, Sq. Miles.	Agg. Area of Basin, Sq. Miles.
Lake Superior	31,200	51,600	82,800
St. Mary's river	150	800	950
Lake Michigan	22,450	37,700	60,150
Lake Huron and Georgian Bay	23,800	31,700	55,500
St. Clair river	25	3,800	3,825
Lake St. Clair	410	3,400	3,810
Detroit river	25	1,200	1,225
Lake Erie	9,900	22,700	32,600
Niagara river	15	300	315
Lake Ontario	7,240	21,600	28,840
	95,275	174,800	270,075

The water surface of Lake Superior nearly equals the combined areas of New Hampshire, Vermont, Massachusetts and Connecticut; Lakes Michigan and Huron together nearly equal the area of the State of New York; Lake Erie, the combined areas of New Jersey and Delaware; and Lake Ontario, about three-fourths of the area of Maryland. The combined area of the lakes exceeds the area of England, Wales and Scotland.

While the line of deepest water does not coincide with the middle line of the lakes, it does approximately coincide with the medial line of the lake basin. Furthermore, with the exception of Lake Erie, the points of greatest depth quite nearly coincide with the center of figure of each basin. This is believed to be a fact never before noticed, and one that may cast some light upon the geological evolution of the Great Lakes.

The length of shore line of the lakes and their connecting rivers is about 5,400 miles, or about equal to the coast line from Maine to the Isthmus of Panama, if the distance be measured along the general contour of the coast, ignoring minor indentations.



Fluctuations of the Water Surface, Rainfall, Areas, Etc., of the Great Lakes.

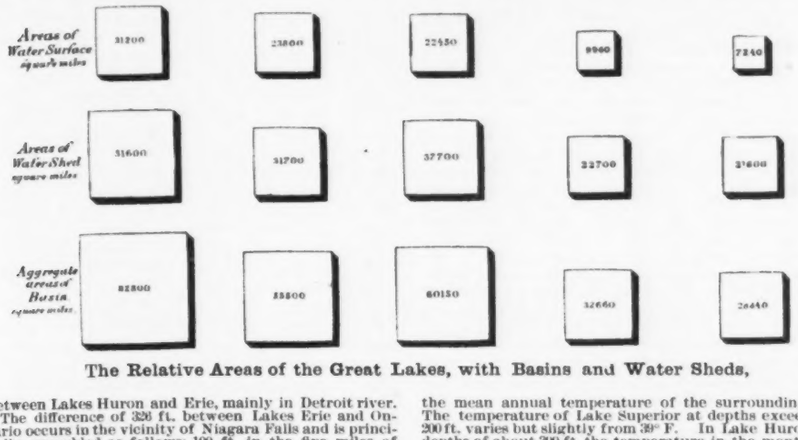
[Reproduced by permission from a large chart showing each of the Great Lakes separately. Compiled and for sale by CHAS. CROSMAN Esq. Milwaukee, Wis. Price $2.00.]

The recently perfected levels of the U. S. Lake Surveys, between tide water and the lakes, fixes the elevation of their mean surfaces above mean sea level as follows:

Lake Ontario	246.6 ft.
" Erie	572.9 "
" Huron and Michigan	581.3 "
" Superior	601.8 "

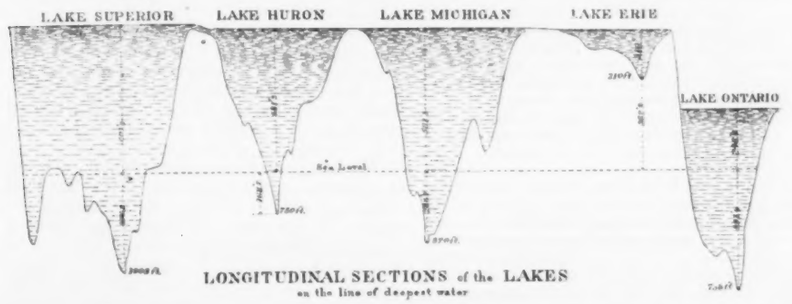
The difference of 20½ ft. between Lakes Superior and Huron occurs in the rapids of St. Mary's river; the 8.4 ft. between Lakes Huron and Erie, mainly in Detroit river.

The difference of 328 ft. between Lakes Erie and Ontario occurs in the vicinity of Niagara Falls and is principally assembled as follows: 100 ft. in the five miles of rapids between Lewiston and the lower Suspension bridge, 10 ft. in the rapids between the bridge and the falls, 160 ft. at the falls, (*) 50 ft. in the rapids immediately above the Falls, and 6 ft. in the upper Niagara river.



The Relative Areas of the Great Lakes, with Basins and Water Sheds.

The mean depth of Lake Superior is about 475 ft.; the deepest point marks a depth of 1,008 ft., or 406 ft. below the level of the sea. Lake Huron has a mean depth of about 250 and a maximum depth of 750 ft. Lake Michigan has a mean depth of 325 ft. and a maximum depth of 870 ft. Lake Erie is comparatively shallow, having an average depth of less than 70 ft. and a maximum of 210 ft. Lake Ontario has a mean depth of about 300 ft. and a maximum of 738, or nearly 500 ft. below the level of the sea. The channels of the rivers connecting the lakes seldom exceed the depth of 50 ft. If the lakes could be drained to the level of the sea, Lake Erie would disappear, Lake Huron be reduced to quite insignificant dimensions, Lake Michigan to a length of about 100 miles with a width of 25 or 30 miles, and Lakes Ontario and Superior, although with diminished areas, would still preserve the dignity of their present titles as *Great Lakes*.



LONGITUDINAL SECTIONS of the LAKES on the line of deepest water

A chemical analysis of water taken from the deepest part of Lake Superior failed under the application of delicate tests to indicate the presence of salt.

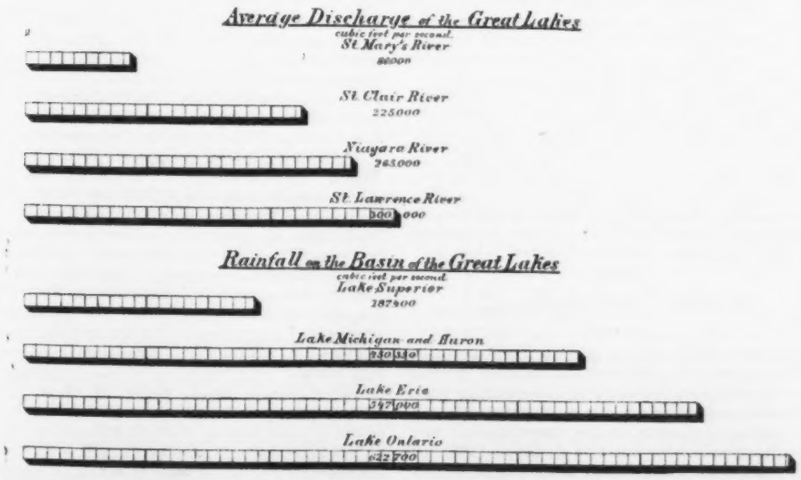
The beds of the lakes away from the vicinity of the shore lines, and at depths exceeding 100 ft., are almost invariably covered with clay. Specimens from the deep soundings of Lake Superior were invariably soft clay varying in color from red to yellow and blue. In the deepest parts the drabs and bluish tints predominate.

The temperature at the deepest points varies little from the mean annual temperature of the surrounding air The temperature of Lake Superior at depths exceeding 200 ft. varies but slightly from 39° F. In Lake Huron, at depths of about 300 ft. the temperature in the months of June and August was 52° F., while at a depth of 624 ft. the temperature was 42° F., the surface temperature being 52° F. and the air 64° F.

The mean annual rain and melted snowfall of the several lake basins is as follows: Lake Superior, 29 ins.; Lake Huron, 30 ins.; Lake Michigan, 32 ins.; Lakes Erie and Ontario, 34 ins. This is about equal to 31 ins. on the entire lake basin.

The following represent the average discharges at the outlets of the lakes:

Lake Superior, at St. Mary's river	86,000	cu. ft. per sec.
Lakes Michigan and Huron, at St. Clair river	225,000	" "
Lake Erie, at Niagara	265,000	" "
Lake Ontario, at St. Lawrence river	300,000	" "



The aggregate discharge of the lakes is double that of the Ohio and nearly equals half the discharge of the Mississippi. The area of the lake basin is a third larger than the basin of the Ohio, or about a fifth the combined areas of the basins of the Mississippi and its affluents. The outflow of the lake basin is slightly less than half the rainfall, while on the Mississippi and Ohio the discharge is about a fourth the rainfall. If the average discharge of the lakes passed through a river one mile wide with a mean velocity of one mile per hour, such a river would have a depth of 40 ft. from shore to shore.

The volume of water in the lakes is about 6,000 cu. miles, of which Lake Superior contains a little less than one-half. Perhaps a better idea of this volume may be obtained when it is said that it would sustain Niagara Falls in its present condition for about *one hundred years*.

In relation to the depth of water on the crest of Niagara Falls, it can be easily demonstrated that if the water passed over the Falls in a sheet of uniform thickness for the entire length of the present water-way, which is about 3,600 lin. ft., the depth of the sheet would not exceed 4 ft. It is highly probable that at the apex of the Horseshoe falls the depth is nearly 20 ft., consequently it may be inferred that the depth of the sheet, except in a few places, is less than 4 ft.

The principal changes in the elevation of the lake surfaces are those due to the wind and to rainfall. Prof. WHITTLESEY states that on Aug. 18, 1848, a gale from the northeast reduced the water level at Buffalo, N. Y., to a point 15½ ft. lower than the surface of the lake on October 18, 1849, at which time a terrible gale occurred from the southwest. This was an excessive difference of level and one of rare occurrence.

During protracted autumn gales, waves have been observed which, through reliable means, measured from 15 to 18 ft. above the normal surface.

The second class of variations, those due to rainfall, occur with considerable regularity. The lowest water in the year generally occurs in Lakes Ontario, Erie, Michigan and Huron in the months of November and March, and on Superior in March. The highest water occurs on the first named lakes in June and July, while on Superior it is delayed until September. The average difference derived from twenty years' observation, between the high and low water of the year is as follows:

Lake Superior, 1.2 ft.; Michigan and Huron, 1.3; Erie, 1.6, and Ontario, 1.9 ft.

The highest observed stage of the lakes occurred in the summer of 1838, and the lowest in the summer of 1847, the difference between the two stages being about 4½ ft.

The water level of the lakes for the last twenty years is shown in the chart and fails to show, as has been claimed any recurring cycle of high or low water.

The curves of the last ten years show a tendency to irregularities which may be due to changes in rainfall and water-shed produced by the rapid destruction of the forests which ten years ago covered the basin of the upper lakes.

Observations made by the U. S. Survey have established the existence of small tides, which at Chicago had an amplitude of 1½ ins. for the neap tide and about 3 ins. for the spring tide.

There is still another class of oscillations called *seiches*, which have been already observed in the Swiss Lakes and for which a solution in all respects satisfactory has not been offered. Whenever the lakes are sufficiently free from the disturbing action of wind to permit observations, a quite regular series of small waves, or pulsations, can be detected, which have an interval of about ten minutes from impulse to impulse. These pulsations seem to occur almost without cessation on Lake Superior. Besides having tides in common with the ocean, the lakes have well defined land and lake breezes; the breeze from the lakes landward commencing in summer at 8 or 10 o'clock A. M. and continuing until sunset and the breeze from the land lakeward from 9 or 10 P. M. until sunrise.

The modifying effect of these large bodies of water upon land areas contiguous to the lakes is noticeable. At Milwaukee, Wis., which is directly upon the shore of Lake Michigan, the mean annual temperature is as follows: Winter, 24° F.; spring, 41° F.; summer, 67° F.; autumn, 49° F.; annual range, 110° F. At points in the same latitude but from 50 to 100 miles inland, the mean winter and autumn temperatures are about 2° F. lower, and mean spring and summer temperatures nearly 5° F. higher, while the annual range is about 5° F. greater."

The rainfall at a point on the shore of each lake is shown on the chart. It is possible that if observations were taken at many stations and the means of areas not exceeding 400 or 500 sq. miles were obtained, the rainfall curve would more nearly coincide with the water level curve, as the amount of rainfall differs greatly at stations but a few miles apart. For example the precipitation at Chicago in 1885 was 44.37 ins., and at Milwaukee for the same period 32.58 ins., showing a difference of 11.79 ins. in a distance of but 85 miles.

EROSION OF THE LAKE SHORES.

Covering a stretch of coast of about 150 miles on the west shore of Lake Michigan, extending from Evanston, Ill., to Manitowoc, Wis., Prof. EDMUND ANDREWS, President of the Chicago Academy of Science, in a very interesting paper on the North American Lakes, published in 1870 (*) gave "the average annual erosion for the whole distances at 5.28 ft.; from Milwaukee to Manitowoc, average, 4.33 ft. a year; from Milwaukee to Evanston, average, 6.24 ft. a year, and at various intermediate points as follows:

Evanston	16.95 ft. a year.
Winnetke	4.05 " "
Lake Forest	1.65 " "
Waukegan	0.00 " "
State Line	16.50 " "
Kenosha	12.00 " "
Racine Point	16.00 " "
Racine	6.00 " "
Oak Creek	2.00 " "
Milwaukee	6.25 " "
Port Washington	2.30 " "
Sheboygan	6.25 " "
Manitowoc	5.00 " "

And at Cleveland, O., Lake Erie surveys show that the erosion for 40 years has averaged about 6 ft. per annum."

AN ACTIVE MOVEMENT has started in Atlanta, Ga., to have the grade crossing nuisance done away with. The movement has not as yet accomplished much, the dispute being as to whether the city or the railways shall pay for the improvements. Each is cordially willing that the other should do so, with assistance from the other side in elaborating plans.

*The height of the Falls is 155 ft. on the Canadian side, 161 ft. near the site of Terrapin Tower and 169 ft. near the east side of the American Falls.

*See Transactions of the Chicago Academy of Science. Vol. 2.

The Laws of Train Resistance.

The Engineer reprints in full the editorial on "Train and Air Resistance" which appeared in our issue of Sept. 1, and publishes in reply the following editorial, which is suggestive and instructive in many ways, although we cannot assent to some of the positions taken. It asks some questions of us which we shall be pleased to reply to in another issue, although space and time forbid us to do so this week. The subject is of vastly more importance than appears upon the surface, and should be studied by every railway engineer. We therefore give *The Engineer's* editorial in full, leaving our readers to digest it for a week before we attempt further discussion.

TRAIN RESISTANCE.

In another page we reprint a thoughtful article which appeared in ENGINEERING NEWS on the 1st instant. It will be seen that our American contemporary takes exception to Dr. LARDNER'S deductions from the experiments which he and Mr. EARLE carried out; and we willingly admit that something is to be said for this view. The whole subject is well worth careful discussion; and is to be regretted that, although numerous and careful experiments have been made to ascertain the resistance of trains, little or nothing has been done to determine how that resistance is made up. There are several factors to be dealt with, namely, rolling friction, axle friction, the resistance of the air, and the waste of energy due to concussion and oscillation. The sum of these resistances is pretty accurately known, but what percentage of the whole each represents is still very much a matter of conjecture. There is, however, no reason to doubt that rolling and axle resistances are very small. If this be granted, then air resistance must be very large. How this resistance operates is a most important point for consideration. Our contemporary takes special exception to the statement that what may be called "head resistance" was shown by LARDNER'S experiments to be practically unaffected by form. It is very easy to fall into error on this point, and it will be well to make the truth clear before going further. What LARDNER said was not that head resistance did not exist, but that its amount was not appreciably affected by form. It is only necessary to stand on the front buffer beam of a locomotive running at speed to ascertain the fact that the air exerts a considerable resistance or push against the advance of the train; but this may be freely conceded, while it is held that putting a prow like that of a ship on the engine would have no effect.

Let us see whether it is or is not reasonable to suppose that a prow would prove useful. It is naturally suggested because the bows of a ship are made sharp to facilitate her passage through the water. But there is reason to think that the analogy between water and air is strained. The work done by the train in passing through an elastic medium like air is diverse from that done by a ship in passing through water, a non-elastic medium. The resistance of the air may be regarded as so much pressure on each square foot of surface. It is a mathematical truth that the total driving force on a piston is independent of the shape of the piston face. Many years ago an ingenious individual, ignorant of mathematics, patented a corrugated piston. The actual superfices of such a piston was, of course, much larger than that of a plain piston, and he took it for granted that a corrugated piston 12 in in diameter would be equal to an ordinary piston of 18 in. in diameter, and that he would thereby effect an enormous saving in steam. He did not know that the pressure of a fluid on a pyramid is measured by the area of its base and not by its superfices. Now it appears to us that it is quite as great an error in the opposite direction to assume that if we fit the leading end of a locomotive with a cone the retarding pressure will be reduced. If the resistance is caused by pressure, then the form of the body driven through the air can have no effect, unless it can be showm that the cone really reduces pressure. To put this in another way, let us suppose that the resistance of the air when a train is moving at 60 miles an hour equals 35 lbs. per sq. ft. So long as this pressure is constant, it will matter nothing what we build on to the front of the engine in the way of cones or prows. It is for those who believe in the influence of form to show that the pressure per square foot will be reduced to something less than 35 lbs. per sq. ft. Let us fit a locomotive with a flat windboard 14 ft. high and 10 ft. wide, The gross pressure on it would be, at 60 miles an hour, say, $140 \times 35 = 4900$ lbs. If we fit on a prow having the same sectional area of base, the resistance to the advance of the train must continue to be 4900 lbs., unless the pressure per square foot is in some way reduced below 35 lbs. Whether this is or is not possible we do not know. We do know that there are very good reasons why it should not be reduced. Possibly our contemporary can advance yet better reasons why it should be reduced, and we shall be glad to hear them, and give them due consideration. Arguments based on a ship will, however, not do. The notion that a sharp bow facilitates the passage of a ship through the water is extremely crude—a relic of the past. The resistance to a ship depends not on the form of her bow alone, but of her whole body. A sharp bow is merely an accidental concomitant of a great deal more.

If our contemporary could see Thames barges with flat bows sloping up from and overhanging the water sailing with a good breeze, he would learn that flat bows are not quite so inimical to speed as he may think. BEAUFOY'S experiments, again, showed that if an equilateral triangle be towed through the water, base first or point first, the resistance is least in the former case. There are besides certain phenomena about the action of a train on air which resemble nothing seen at sea. Thus, for example, when a train is moving at a high speed, there is a powerful current of air rushing in the opposite direction at each side of the train. On the Caledonian Railway, north of Carlisle, aspen and birch trees grow in some places quite close to the line. The flying express last August consisted of four coaches. Sitting in the next coach but one to the engine, it was easy to see as the train tore past the trees at over 60 miles an hour that they were powerfully blown back by a fierce wind, set up by the passage of the train. Before we saw this, if we had been asked an obvious question on the subject, we should have replied that the train would carry a body of air forward with it, which would cause the trees to bend forward in the direction which the train was taking. That answer would have been wrong. Those who have stood on the platforms of stations as the train ran through at high speed, say that it was followed by a perfect tornado, which scattered sand, dust, and even little stones in the wake of the train. It is clear that the bulk of a train must have a powerful effect, acting, as it does, as a displacer.

For the moment we shall leave most of our contemporary's arguments untouched, because it would only complicate and confuse the issue if we attempted to traverse too much ground. There is enough and to spare to be said on one point alone raised by ENGINEERING NEWS, viz.: the influence of the form of the leading end of the engine on resistance. It is clear that our contemporary recognizes the difficulty of the subject to some extent, but not, we think, fully. It is argued usually that it is just the same thing to move a body against still air, as air against a still body. It is on this assumption that anemometers such as those used in mines to measure the velocity of air currents are calibrated. The instrument is secured to a revolving arm moving in the still air of a room. The velocity with which it passes through the air is known, and the number of revolutions made by the fan in a given time under the circumstances of the test being known, it is assumed that if the instrument is exposed to a current of air it will *cæteris paribus* make the same number of revolutions. Most probably the deduction is quite accurate for small surfaces like those of a fan; but can the deduction be accurate for large surfaces? It has been proved at the Forth bridge that the pressure of the wind on any given surface of considerable area is one-half the pressure on any square foot of that surface. This mathematical impossibility is nevertheless an undisputed fact, only to be explained on the assumption that air currents, or otherwise wind, are very irregular in their action. Thus we may have two boards, one with an area of a square foot, the other with an area of 100 sq. ft. The maximum pressure on the former may reach, say, 30 lbs., while that on the latter will never exceed 1,500 lbs., and this although they stand side by side. It appears that excessive wind pressures occur in threads or streams, so to speak, in the advancing body of air. When, however, the air is at rest, and a surface is passed through it, there is every reason to conclude that the pressure will be equally diffused over the whole area, because it is not easy to see how in such a case threads or streams of high pressure could be set up.

The statement with which our contemporary concludes is so remarkable that we cannot comment on it until we are sure that we understand it aright. It is that at high speeds the internal resistances of a locomotive engine amount to more than 50 per cent. of the total power exerted—that is to say, an engine indicating 500 H. P. at 60 miles an hour only expends 250 H. P. in drawing the train. Such a remarkable proposition as this requires careful propping with selected facts. Is it too much to ask our contemporary to let us have a few.

New South Wales Railways.

Parliament was prorogued on July 24, and a considerable quantity of miscellaneous business having been disposed, the Houses were dispersed for their holidays. A slight hitch was anticipated over the new railway proposals of the Government. Mr. JAGO SMITH raised the question as to the difficulty with regard to the 13th section of the Public Works Act, which renders it necessary that a report on the probable cost of the proposed railway lines should be received from the Railway Commissioners before the proposals could be submitted to the Public Works Committee. Sir HENRY PARKES said that it might seem strange that, as he conducted the Bill through the House, he should have omitted to observe this particular provision; but the matter had only just been brought before the Cabinet, and when he saw the importance of the difficulty, he took steps to obtain the opinion of the Attorney-General upon the subject. The Attorney-General's opinion was to the effect that no proposed railway could be legally submitted or explained to the Legislative Assembly under sub-section 1 of clause 13 of the Public Works Act of 1888, unless there was a report of the Railway Commissioners to be appointed under that Act on the probable cost of construction. The Premier subsequently made a statement with regard to the railway lines which the Government intended definitely to put before Parliament. These were as follows:—A line from Moss Vale to Robertson; a line from Narrabri to Moree: a line from the Illawarra railway to Kurnell; a line from Tempe to Long Nose Point, Balman: a line from Kiama to Nowra; a line from Culcairn to Cowra; a line from Westmead, near Parramatta, to Dural; a line *via* Parkes and Molong towards Wilcannia, connecting also by a branch line the town of Parks with Forbes; a line from Grafton to the Tweed River; a line from Eden to Bega; a line from Goulburn Crookwell; a line connecting the Nort Shore railway with the waters of Port Jackson at Milson's Point; a loop line from Marrickville to Liverpool; and a line from Jerilderie to Deniliquin. With regard to the proposed railway from Inverell, in consequence of a deputation having waited on the Premier and adduced many powerful arguments, the Government had decided to fairly consider the expediency of carrying a railway from Inverell to Glen Innes. They had also decided to call for reports as to the practicability of extending the railway from the present terminus at Redfern to the western portion of the city.

The annual report of the Commissioner for Railways has been issued. At the close of 1887 the mileage opened was:—Southern system, 780; Western system, 613; Northern system, 496¼. The extensions opened during the year 1887 were; Clifton to Wollongong. 12 miles; Bungendore Queanbeyan, 17¼; Wollongong to North Kiama, 22: Queanbeyan to Michelngo, 30; Hornsby to Hawkesbury, 15; Gosford to Waratah, 50; making a total of 146¼ miles. The total mileage in operation at the close of the year was 2,036. Since the close of the year the following extensions had been opened:—Mullet Creek to Gosford, 10 miles; Tenterfield to Wallangara, connecting with the Queensland Railways, 14, miles: Cowra to Blayney, 45 miles; making the total in operation 2,102. The tramways come out badly in the report. As compared with the transactions for 1886, the returns for 1887 showed a decrease in the total earnings of $59,865, causing a fall in the return upon the capital invested from 3.32 per cent. to 1.76 per cent.—*Colonies and India.*

The Growth of the Electric Motor.

The opening of the line of electric street railway in Bangor, says *The Portland Press*, which will probably take place in a few days, will be an event of considerable importance, especially as a landmark in the great march of electrical improvement. Five years ago electrical industry was in its infancy in this country. The electric light was a wonder heard of but not seen by the great mass of the people of Maine. To-day, along the Kennebec and other rivers, even farm-houses adjacent to water-powers, are equipped with incandescent lights. In the United States there are to-day 5,351 isolated plants and central electric light stations, producing 195,500 arc and 1,925,000 incandescent lights. There are employed for the motive power of dynamos steam engines aggregating 459,495 horse-power and the capitalization of electrical companies during the last six months has increased $42,210,100. There are now operated in this country 34 electric railways, comprising 138 miles of single track, while 49 other roads, with an aggregate length of over 300 miles, are in course of construction. Careful estimates show that no less than 17,500,000 passengers will be carried by the electric roads of the country during the present year. The increase of the business is strikingly illustrated by the fact that there are single factories employing as many as 1,500 persons making electric motors. There are eight journals devoted exclusively to electricity and its dependent industries in the United States.

This great progress is the work of only about half

a decade. If we look back a whole decade, or a decade and a half, the changes that meet our eyes are such as a writer of Arabian Nights tales would not be ashamed to attribute to the most powerful of genii. The telephone, the phonograph, the electric motor bringing great power for miles over a slender wire, all these have come to the use and advantage of the people of this country since the schoolboy was in his cradle. Speaking of this wonderful progress, Mayor Hewitt, of New York, one of the most enlightened and far seeing men of practical affairs in any country, said to the members of an electric convention: "Already the wonders performed by the modern electrician surpass a thousand-fold anything that was done by the astrologers of old. But you are at the threshold of possibilities as Watt was when he produced his first steam motor. The revolution accomplished by steam power in the short space of time within the memory of many here is to be continued and in all probability outdone by the new force we call electricity. The possibilities presented by the use of this great power are infinite. It may even be destined to solve the problems of inequality of fortune and others which confront the world by placing a cheap power within the reach of all."

Manila Hemp in Plaster.

For years, says the *Manufacturer and Builder*, a well-known firm of architects has ordered the use of manila hair in all plastering work done for its clients. In order to satisfy the doubts of some of the contractors, they made the following experiment: The test was made with four plates of equal size, one containing manila hemp, the second sisal hemp, a third jute, and a fourth plasterer's hair (goat's) of the finest quality. The test was made by suspending weights from the middle of each plate, the ends of which were properly supported. The result was that the plaster mixed with goat's hair broke at 144½ lbs. weight, that with jute at 145 lbs. the sisal at 150 lbs., and the manila at 195 lbs. It should be added that the plaster containing the manila hemp did not break; it cracked. Though cracked in the centre, the lower half of the plate containing the manila when it was suspended, held on to the upper half, and the manila held it fast, though the observer would almost feel confident that the hairs would break under the strain. The three other plates were broken—that is, the two parts of each plate had severed entirely, in contrast with the manila plastering. The architects felt that their theory had proved correct.

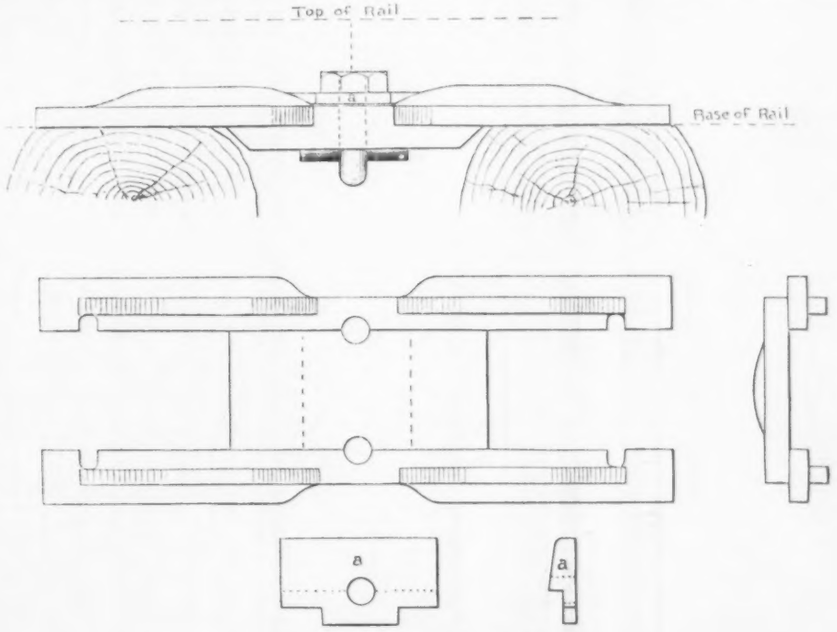
Another experiment, made two years ago by a member of the same firm of architects consisted of mixing two barrels full of mortar, each containing equal portions by measure, of sharp sand and Thomaston lime, one of the barrels, however, being mixed with the proper quantity by measure, of manila hemp, cut in lengths of 1½ to 2 ins. and the other of goat's hair, the best that could be procured. After mixing thoroughly with the usual quantity of water, the respective mixtures were put in the cellar, where they were locked up. They were allowed to remain there for nine months, at the end of which time they were opened and examined. The hair morter crumbled and broke apart, very little of the hair being visible, showing that the lime had consumed the hair. The other, containing the hemp, however, showed great cohesion, it being with considerable effort that it was pulled apart, the fibres of the hemp permeating the mass and giving little or no evidence of injury done to it by the lime.

UTILIZING RAILWAY EMBANKMENTS.—A correspondent of the English *Gardener's Monthly* is surprised that railway embankments are not utilized for the cultivation of wall-fruit, etc. He notes one case where nearly half-an-acre of straw-berries were planted on such an embankment and are doing well. In Belgium railway fences are paralleled by cordons of apple and pear trees, which yield a goodly revenue. This might do in the thickly settled regions of England and Europe where all tillable land has a decided value; but in America, land is hardly scarce enough to profitably tempt the cultivator of railway slopes, and the fruit crop referred to might on our exposed lines be gathered by others than the rightful owners.

The Foster "Bridge" Rail Joint.

The fact that the ties have either to be cut into or to be set lower than the other ties when the rail joints are not opposite, is an objection that has been urged against the Fisher bridge joint. The accompanying engraving shows a form of bridge joint which has been designed by Mr. WOLCOTT C. FOSTER, C. E., with the purpose to overcome this difficulty. How perfectly it has been overcome may well be questioned, but the design at least has interesting features.

The ends of the joint rest on the ties while the bed-plate, to which the rail ends are bolted, only fills up the space between the ties, its upper surface being level with the surface of the ties. On the under side of the bed-plate is a rib running longitudinally in order to prevent the joint from bending. The ends resting on the ties are ribbed on their upper surface in order to add to their stiffness. The method of fastening the rail to the joint, and the whole principle of the device, otherwise than as stated, is similar to that employed on the Fisher joint.



The Foster "Bridge" Rail Joint.
[One-sixth full size.]

It is apparent at once that the cost of manufacturing a joint of this kind must be somewhat larger than for the ordinary form of Fisher joint, and its danger of breakage, it seems to us, greater; but as that danger has proved to be almost *nil* in the Fisher joint, it is not clear that this danger would be increased to any objectionable extent. The cutting away of the side ribs at the center does not appear desirable, but with that exception we cannot see any other reason than the cost of manufacture why this should not make a thoroughly good joint, preserving all the essential features of the Fisher joint, whose value we have repeatedly recognized, while doing away with an objection which has been very generally felt and expressed.

The most valuable feature of that device, doing away with narrow bearing surfaces, holding the two ends of the rails immovably together, and instituting a bridge action by which, whether the load be on the joint or on either side, the pressure is distributed continously and with approximate equality to both the ties on each side, instead of first to one and then to the other; all these are fully preserved. The metal cut away from the base-plate over the ties is certainly no loss as respects bearing surface, for it is merely interposed under another excellent bearing surface, the base of the rail. We are of opinion that, were the wings of the joint wholly cut away and only the U-bolt and narrow base plate retained, it would make about as good and serviceable a joint as ordinary angle-bars, since, however, defective in other respects, it would accomplish perfectly what the fish-plate does very imperfectly, hold the two ends of the rail in a truly horizontal position, so that both must go down together if at all, instead of permitting them more or less play upon each other. It would appear as if four wings of the form shown would have quite sufficient bearing surface to maintain efficient bridge action, since the full bearing surface of both rail-bases is brought into action likewise through the U-bolt. The saving in metal from the base-plate would enable considerable extra expense to be put in manufacture; and while we do not like the cutting away of the ribs at the center, we think it possible that the main idea of the device would prove a good one in service.

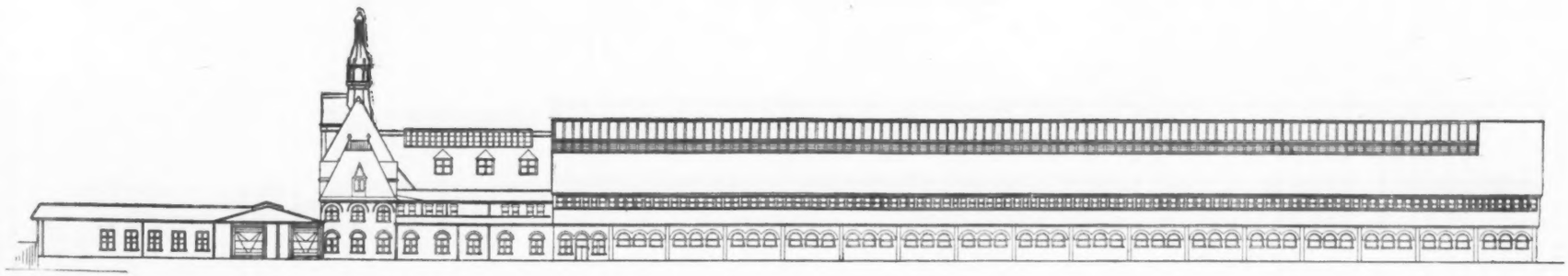
The Black and Caspian Sea Canal.

The following sketch of this long talked of among ship canal enterprises is translated from the last issue of *Le Canal de Corinthe*: The point of departure of the canal is on the river Volga at Serepta, just where this great river makes a sharp bend towards the southeast. From this point to Tsaritsine, on the river Don, is about 53 miles, which is the length of the canal. There is only one inconsiderable river on the line of the canal, the country traversed is practically uncultivated and land is thus cheap, and a railway now runs parallel to the proposed canal direct to Moscow from the Volga.

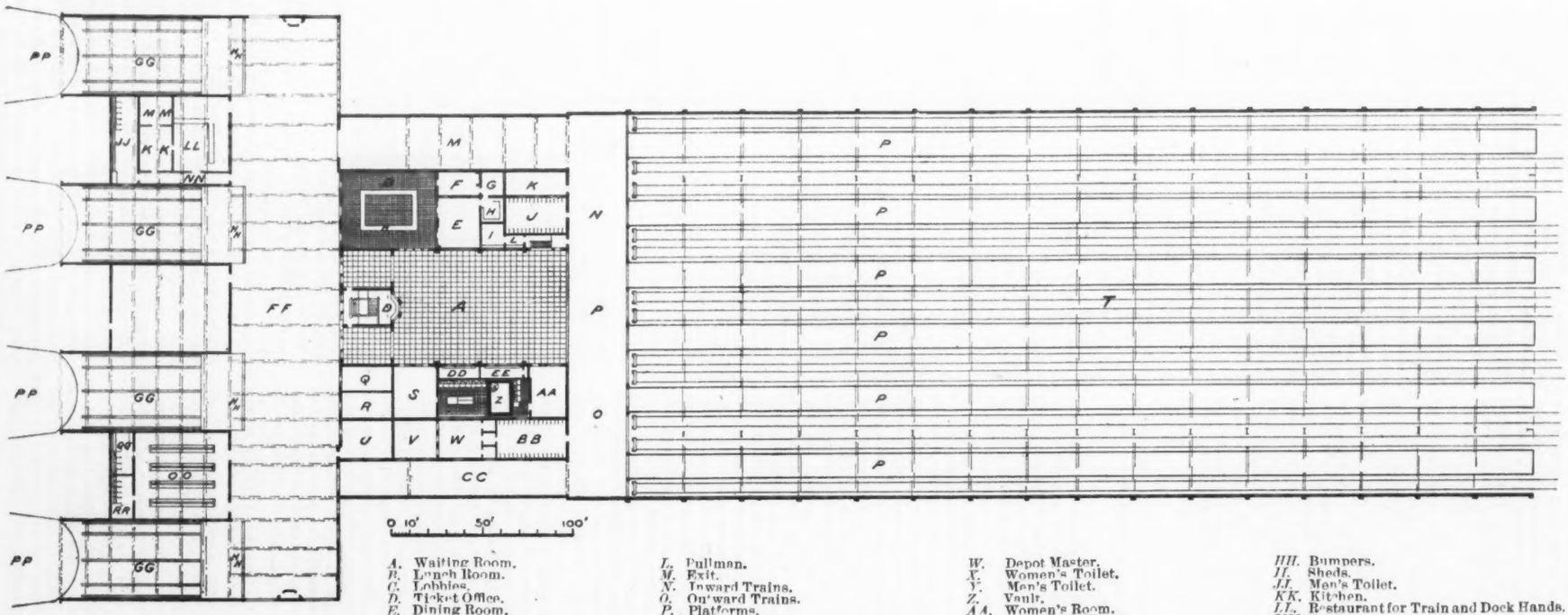
Boats 230 ft. in length will be able to use the canal, and along its length will be some 44 stations, not including the new port to be established on the Don. A hill about 128 ft. high lies in the path of the canal, and this must be pierced. The total excavation is estimated at about 35,000,000 cu. yds., of which just one-half is in the deep cut mentioned. Vessels 230 ft. long and 40 ft. wide, carrying loads of 500 or 600 tons, can make the trip through the canal in 70 hours; ships of war of smaller dimensions can pass through in 24 hours. An iron bridge costing $100,000 will be built at the junction of the canal with the river Tcherviennaia, and there will be besides this about 14 other iron bridges. There will be also 17 supply reservoirs, covering about 1,000 acres.

The cost of the canal is estimated at $14,000,000, exclusive of the expense of raising this capital and of administration during the continuance of the work. The digging of the canal proper and the construction of the reservoirs is figured at $8,000,000, and $4,000,000 is set aside for the locks; the remainder will be expended in buildings, bridges, machinery, lighting, etc. The number and lift of the locks is not stated in the original article.

STEEL RAILS weighing 90 lbs. per yd. have recently been rolled by the Bethlehem Iron Co., of Bethlehem, Pa., for use of the Reading railroad.



Longitudinal Elevation; Jersey City Depot, C. R. R. of N. J.

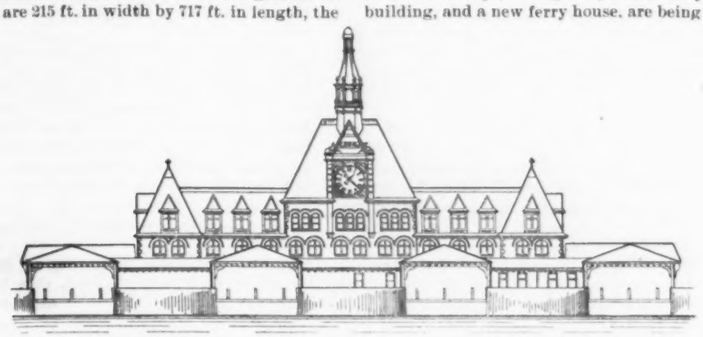


A. Waiting Room.
B. Lunch Room.
C. Lobbies.
D. Ticket Office.
E. Dining Room.
F. Kitchen.
G. Stores.
H. Serving Room.
I. Telegraph.
J. Conductor's Room.
K. Truck.
L. Pullman.
M. Exit.
N. Inward Trains.
O. Outward Trains.
P. Platforms.
Q. Lost Articles.
R. Storage.
S. Men's Room.
T. Train House.
U. Ferry Supt.
V. Baggage Master.
W. Depot Master.
X. Women's Toilet.
Y. Men's Toilet.
Z. Vault.
AA. Women's Room.
BB. Brakemen's Room.
CC. Baggage Passage.
DD. News Stand.
EE. Fruit Stand.
FF. Ferry House.
GG. Bridges.
HH. Bumpers.
II. Sheds.
JJ. Men's Toilet.
KK. Kitchen.
LL. Restaurant for Train and Dock Hands.
MM. Stores.
NN. Passage.
OO. Emigrant Waiting Room.
PP. Ferry Slips.
QQ. Men's Toilet.
RR. Women's Toilet.

Jersey City Depot of the Central Railroad of New Jersey; Plan.

The New Depot of the C. R. R. of N. J.

The depot now being built by the Central Railroad of New Jersey at Communipaw will be one of the most substantial and ornate on the western side of the river, and will be by far the largest and most commodious. The building is of brick and iron, with stone trimmings in the front. The general dimensions are 215 ft. in width by 717 ft. in length, the train shed being 512 ft. long. The accompanying plan and front and side elevations convey a clear idea of the arrangement of the ground floor and of the appearance of the exterior.



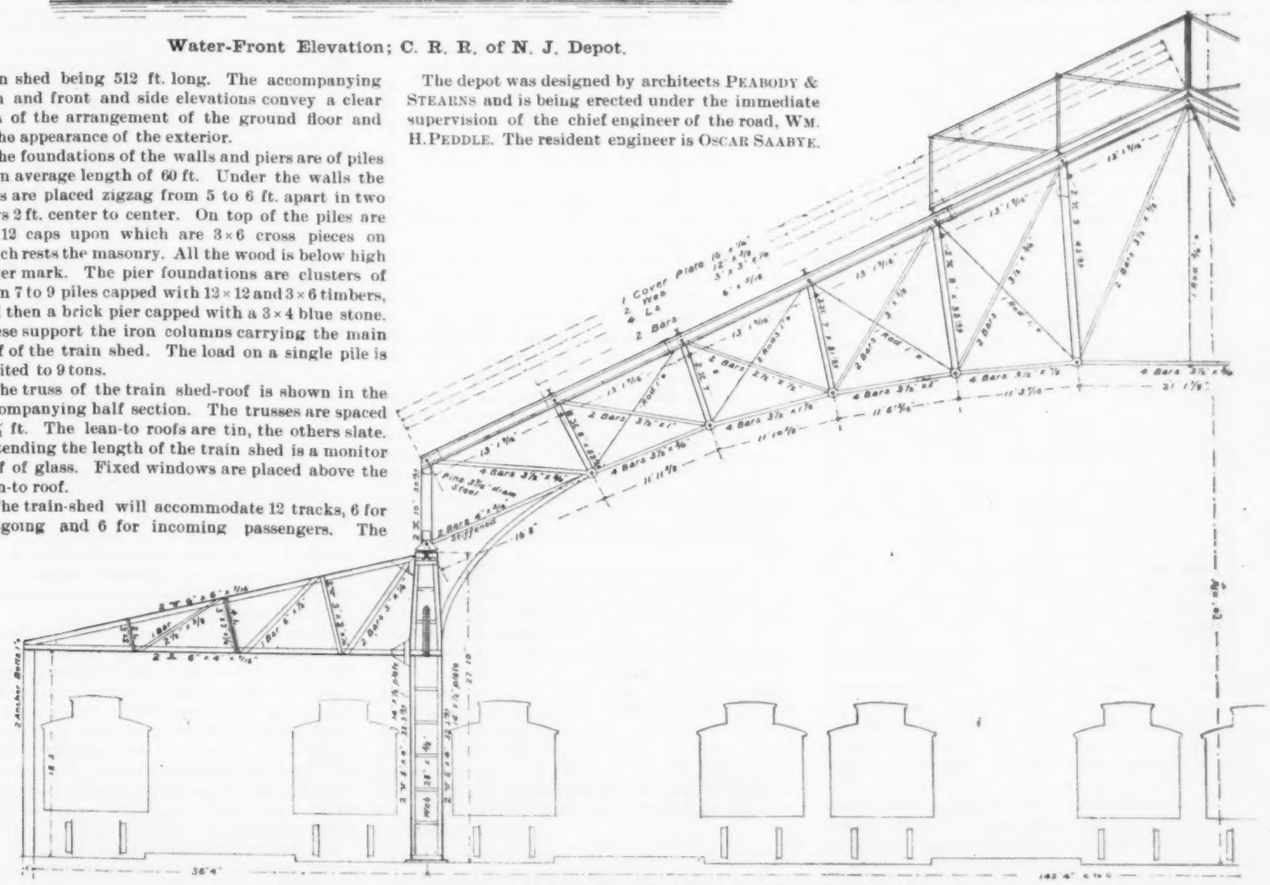
Water-Front Elevation; C. R. R. of N. J. Depot.

The foundations of the walls and piers are of piles of an average length of 60 ft. Under the walls the piles are placed zigzag from 5 to 6 ft. apart in two rows 2 ft. center to center. On top of the piles are 12×12 caps upon which are 3×6 cross pieces on which rests the masonry. All the wood is below high water mark. The pier foundations are clusters of from 7 to 9 piles capped with 12×12 and 3×6 timbers, and then a brick pier capped with a 3×4 blue stone. These support the iron columns carrying the main roof of the train shed. The load on a single pile is limited to 9 tons.

The truss of the train shed-roof is shown in the accompanying half section. The trusses are spaced 32½ ft. The lean-to roofs are tin, the others slate. Extending the length of the train shed is a monitor roof of glass. Fixed windows are placed above the lean-to roof.

The train-shed will accommodate 12 tracks, 6 for outgoing and 6 for incoming passengers. The tracks are arranged in pairs, separated by concrete walks, 13 ft. 10 ins. wide.

The depot was designed by architects PEABODY & STEARNS and is being erected under the immediate supervision of the chief engineer of the road, WM. H. PEDDLE. The resident engineer is OSCAR SAABYE.



Half-Section, Showing Roof of Jersey City Depot; Central Railroad of New Jersey.

The waiting room in the center of the head house is 85 ft. 4 ins. in length, and 66 ft. 8 ins. in width. The ticket office is located at the entrance, and at the sides are news stands, restaurant, private rooms, etc. The walls are of English cream colored glazed brick, and the flooring of blue stone. This room is lighted by 3 large dormers and a skylight extending the whole length. All the other rooms upon this floor are finished in North Carolina hard pine, the ceilings being formed by the beams and flooring of the second story. The exit for incoming passengers, on the south side of the building, is 29 ft. wide, is paved with concrete and walled with English brick. The platform between the head-house and train shed is 31½ ft. wide. The baggage passage is on the north side of the depot.

The vault measures 17 by 10½ ft. inside. The foundation consists of three rows of piling (longitudinal) carrying arches supporting the floor which is on a level with the main floor. The center wall is 12 ins. thick, the outer ones 24 ins. In the latter is a 4-in. air space. The vault is entered from the second floor by means of a spiral stairway.

The upper stories of the head house are to be used as offices.

Four new slips, arranged symmetrically with the building, and a new ferry house, are being built.

CORRESPONDENCE.

The History of "Extra" Tunnel Excavation on the New Croton Aqueduct.

TARRYTOWN, N. Y., Sept., 26, 1888.

EDITOR ENGINEERING NEWS:—

In the matter of the amount of tunnel excavation due the contractors under their contracts on Sections No's. 2, 3, 4 and 5, of the New Croton Aqueduct, I would submit the following bit of history:

There was adopted a system of timbering which required less excavation and less masonry, than the mimimum timber Section No. 16 of the original city plans; the question arose as to who was entitled to the benefit of this saving, the city or the contractors? In February, 1886, the Chief Engineer ruled that the city was entitled to it; this ruling was in effect that if a cross-section of excavation was ordered by the engineer, and if the contractor succeeded in accomplishing the desired results, with less excavation than the cross-section ordered, that they were to be paid for only the actual amount of excavation they did. The Corporation Counsel's opinion given at that time agreed with this ruling.

The Aqueduct Commissioners did not decide upon lining the tunnel throughout with masonry until some time in the year 1886; in consequence of which the masonry lining in the tunnel proper was not commenced until late in that year. As the work was conducted, the excavation was not completed and the engineer did not determine the cross-section of the tunnel excavation until just before the lining masonry was put in place. Clause F., Part 17 of the contracts reads: "The form and area of the cross-section of the tunnel excavation at any place shall be such as the engineer may determine for that place."

In January, 1887, or shortly after the masonry lining was begun to any extent, the contractors complained that they were not being estimated for the tunnel excavation in accordance with the contract. The Aqueduct Commissioners referred the matter to their Chief Engineer; as the contract provided in Clause B, which reads: "To prevent all disputes and litigation, it is further agreed by and between the parties to this contract, that the engineer shall in all cases determine the amount or the quantity of the several kinds of work which are to be paid for under this contract."

Paragraph 51, clause F. of contracts reads: "The plans and specifications are intended to be explanatory of each other, but should any discrepancy appear, or any misunderstanding arise as to the import of anything contained in either, the explanation and decision of the Chief Engineer shall be final and binding on the contractor; and all directions and explanations required, alluded to, or necessary to complete any of the provisions of these specifications, and give them due effect, will be given by the engineer."

The above two clauses of the contract plainly show that the engineer is the proper person to in-

terpret the contract, and decide as to the amount of tunnel excavation to be paid to the contractors.

Under date of Feb. 7, 1887, the Chief Engineer reported on the matter, from which report we quote the following:

Chief Engineer's Office, Aqueduct Commissioners.
Room 215 Stewart Building.
NEW YORK, Feb. 7, 1887.

To the Hon. the Committee on Construction of the Aqueduct Commission.

GENTLEMEN:

I respectfully submit the following report in answer to the statements before you of the contractors and the written communications of Brown, Howard & Co. O'Brien & Clark, etc.

Their statements, viz: "That the allowance made to us in your approximate monthly estimates for tunnel excavation is less than the area of space used for the construction, masonry supports, maintenance and safety of the New Croton Aqueduct," is correct and was made necessary by unavoidable delays in increasing my office force to complete final tunnel sections for making exact estimates of work done. The request of the contractors that estimates be made, viz: "We therefore, respectfully request that we be estimated for the excavation of the space excavated by us, and used and occupied by the masonry required to support the rock or earth in tunnels," is just and reasonable to the extent covered by the contracts as stated below, viz: The contracts require that masonry be built and paid for in unavoidable vacancies, outside of minimum tunnel section (of 201 sq. ft.) and also in tunnel sections which break (owing to the character of the rock) larger than the minimum section called for, including loose and shaky rock, ordered removed, provided "the drilling and blasting has been conducted with all possible care, etc." The contracts require that the engineers, shall, in all such cases (See Clause B of thecontract and F, and No's. 2, 17, 19, 21, 22, 24 general clauses No. 49, 51, T of the specifications) determine the lines of the cross sections to include unavoidable excavation outside of the minimum section given to guide the contractors in placing their marginal drill holes for blasting.

The minimum section indicated by the line *AAA*, on contract drawings, is given to guide the contractors in so placing their drill holes that the tunnel excavation may not be less, and as little over the minimum section as is practicable. The specification, in my judgment, requires the engineer to establish limiting lines of tunnel cross section to include the part occupied by masonry, and all excavation outside of the lines marked *AAA*, on the contract drawings, to the extent that in his opinion, results from good blasting, and well placed drill holes, for the purpose of securing only the minimum section illustrated in the contract drawings. See clauses B and T, of the contracts; also F, No.'s 2, 17, 19, 21, 22, 23, 24.

The contract and specifications make it mandatory, in my opinion, that tunnel sections shall be established for measuring tunnel excavation. It is included in classified work, to be paid for by the cubic yard, *because* the amount could not be ascertained before its execution, as the character of the rock to be excavated, and consequently its amount could not be accurately foretold.

The contracts hold the engineer responsible for protecting the city against avoidable excessive excavation and amount of masonry caused by careless or unskilled blasting.

After the Chief Engineer had submitted his above report, steps were immediately taken to coerce him, and not permit him to estimate to the contractors in accordance with the said report. Resolutions were passed embodying the interpretations of the contract by individual members of the Aqueduct Commission; and the Chief Engineer was directed to prepare supplementary rules; one of which, when he read it to the Committee on Construction, he stated, in explanation, was gotten up to suit the views of a Commissioner who was then absent; that it did not embody his own views, and that his report under date of Feb. 7, 1887, did contain his views as to the amount of tunnel excavation which the contractors were entitled to payment for under their contract.

At the suggestion of the Commissioners, several other supplementary rules were prepared and presented by him. The counsel to the Corporation was called upon to give his opinion on the reports and rules which had been presented, and was asked to prepare rules which he considered would be in accordance with the contracts. He gave six opinions, each of which was construed differently by the different readers. The counsel to the Corporation was informed that the contract should be susceptible of a rule to govern the estimating of the tunnel excavation, otherwise fault should be found with those who drafted it and approved of its form; in one of his opinions he advised that no rule be adopted, as it might embarrass those who had to defend the city, that the contract itself should be the guidance. The Committee on Construction adopted the report dated Feb. 7, 1887, of the Chief Engineer; but at the next meeting following the counsel to the Corporation presented an opinion that said report was not in accordance with the contracts. The Commissioners then rescinded all rules and resolutions which they had adopted in this matter, and passed a resolution directing the Chief Engineer that in estimating for tunnel excavation in the future he was to be guided by the contract, but they verbally directed him to be guided by the opinions given by the counsel to the Corporation. The Chief Engineer then estimated to the contractors from May, 1887, to December, 1887, in accordance with (or as near as was thought possible) with the suggestions contained in the several opinions of the counsel to the Corporation, and not in accordance with his (the Chief Engineer's) report of Feb. 7, 1887; these estimates allowed the contractors a portion only of the tunnel excavation.

In September, 1887, a scheme was gotten up by the city officials to force the contractors into accepting as a final, the portion of excavation as then estimated, or else to take that portion then allowed away from them, and compel them to go to the courts for the whole of it. The counsel to the Corporation, the Comptroller, and three of the Aqueduct Commissioners, were then appointed as a committee to investigate the matter; and after several consultations, and after thorough investigation into their method of estimating for the contractors, they formulated a typical cross-section which enunciated their claimed interpretations of the amount of tunnel excavation that was due the contractors under the contract. In effect it was a little less allowance than the contractors were being estimated for at that time. This typical cross section was offered to the contractors as a basis of settlement, instead of the basis embodied in the report of the Chief Engineer of Feb. 7, 1887. The contractors charged that the Commission was scheming to force them into accepting less than they considered their just dues, and refused to give a reply to the proposition until the Commissioners assured them that there would be no attempt on their part to take away from the contractors the portion already allowed to them. The contractors still refused to accept the proposition offered.

Sometime after, December 30, 1887, the Aqueduct Commissioners by unanimous vote adopted the resolution which the typical cross-section enunciated, and since that time we have been estimated in accordance with it. Estimated, but not paid; the money was withheld on the pretext of finding bad work in the rubble masonry; and now that this bad work is about all repaired, so that the contractor's money cannot be longer withheld on that pretext—they say that they withhold it because they were estimated for too much excavation; evidently renewing the scheme which was attempted last December to force us into accepting less than what we consider our just dues—and ignoring their promise to the contractors last December.

Inasmuch as the contract provides "that the cross-section of the tunnel excavation was to be determined by the engineer, and provides that *he* was to be the sole judge, whose decision was to be taken; and he having made such decision, viz.: that all the excavation outside of the line *A A A*, which resulted from good blasting was to be paid for; and the work having been conducted under that principle, now that the work is completed, we believe we should be paid in accordance with that decision, and that the city of New York is in honor bound to pay it to us, and should not permit its representatives to force us into a law suit to collect it.

D. D. MCBEAN.

[It is only proper to state that the letter quoted above and ascribed to "the Chief Engineer" is not published among the "Reports and Documents" presented to the late Senate Investigating Committee, and verified by the President of the Aqueduct Commission. But some report of the Chief Engineer of the date of Feb. 7, relating to the amount of excavation to be allowed to contractors under the contract, is frequently referred to at the meetings of the Commission on March 21, 28 and 30; and as the report was evidently satisfactory to the contractors, it was probably of a tenor, at least, similar to the one given.—ED. ENG. NEWS].

The Cascade Bridge.

PORTLAND, Oregon, Sept. 16. 1888.

EDITOR ENGINEERING NEWS:

In your comments on the letters published by you concerning the Cascade bridge, you declare they "give both sides of a question, etc.," to which I reply that I have not occupied any "side" in the matter in any sense whatever. I was employed to do a certain specific work in the line of my profession. I did the work, and in my letter to ENGINEERING NEWS told the history of the Cascade bridge so far as I knew it; and succeeded thereby in unintentionally wounding the vanity of the designer of the work, who is led thereby not only to attack me, but likewise a man who is no longer living to answer for himself.

As to myself, let the matter pass, but the evidence of Mr. MCCALLUM'S genius was shown in his career on the New York & Erie. He began as a carpenter in one of the shops, and advanced rapidly to the position of foreman of a gang of bridge repairers. In that duty he gave such evidence of ability in organizing forces and conducting work, that he soon came to be made a Division Superintendent of bridges from which it was only a step to be appointed General Superintendent of bridges for the entire line.

He had exhibited so much original talent for construction while thus engaged, that he "obtained authority for conducting, at the expense of the company, a most extensive series of experiments on timber bridges." The result of these experiments was the development of what was known as the MCCALLUM truss, probably the most perfect wooden bridge that has yet been devised; a system that soon replaced the structures in general use on the line.

Mr. MCCALLUM'S genius for organization and administration was so marked that on the occasion of a vacancy, the same corporation which had employed HORATIO ALLEN, Major BROWN, JAMES P. KIRKWOOD and the Cascade Ravine genius, invited him to take charge of their line as its General Superintendent.

This was the man who is spoken of so contemptuously because he thought a wooden bridge of extraordinary dimensions across a ravine with precipitous sides was a threatening danger on a great through route. He recognized that if the bridge was destroyed by fire, the traffic of the line over that point could not be continued without immense delay. Passengers could not cross the gulch on foot and freight would stand no better chance.

That such a danger was imminent was illustrated in its great neighbor destroyed by fire but a few years after the removal of the Cascade bridge, compelling for several days the tramping of passengers and the delay of trains.

But even if the figures presented in the letter of which I am treating be correct, which I deny on good authority, the bank with a proper culvert or a tunnel where it was finally placed was indicated as right in the first instance.

The whole thing it appears could have been built for a trifle over $100.000. The Cascade bridge cost, according to its distinguished engineer, $40,000; to replace it with an iron structure, as you suggest might have been done "ten or fifteen years" later, would have cost $70,000 more, thus the two bridges would have cost as much as a permanent work and would not have been permanent. They would have been for all time of their duration a menace to safety, as all bridges are when compared with permanent works.

If the company was crowded for money and so forced to a temporary expedient, a timber trestle costing $12,000 would have been suggested to an engineer of less "genius" and innocent of an ambition "to build the largest span railway bridge then extant."

As to your conclusion that the purpose was to pass *all* the water through the rock bank, I can only say that such was not the design of the plan I submitted, which must certainly be in the archives of the company. As I have before said, I had nothing to do with the construction; my duties being limited to the surveys, estimates and plans for the work. The point you made in the original article I have never disputed, and I certainly appreciate its value. But I am rather surprised at your statement that "the early plans of bridges have passed out of use." An exploration of this wooden northwest would warm your heart's memories if you are as old as I am.

It is not true that "at that time" Mr. MCCALLUM had a subordinate called an Assistant Engineer. He had four Division Superintendents, all civil engineers and all men of high character. Naturally enough they were the "Subordinates" of the General Superintendent and one of them, HUGH RIDDLE, became his successor.

In conclusion, I will merely remark that, so fas as I know, there has never been a duplicate of the Cascade Bridge, but I have seen hundreds of McCALLUM bridges all over the American Continent.

ALFRED SEARS.

[What we intended to say as to the McCALLUM, as we supposed would be clear, was that that and all other "early types of bridges" prior to the Howe truss, "have now passed out of use" in favor of the Howe type of wooden truss bridge, which may be said to be the only one warranted by modern practice. Our conclusion that "the purpose was to pass *all* the water through the rock bank" referred only to the work as originally carried out, and not at all to the details of the original design for the work. It is apparent and unquestionable, however, that there was no real purpose of putting through a tunnel when the work was executed, or it would have been executed differently.—ED. ENG. NEWS.]

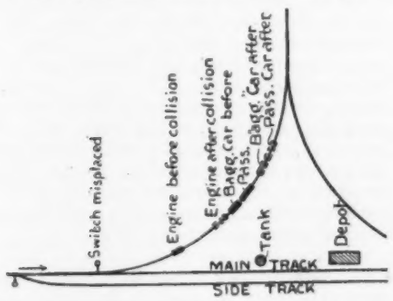
No Switch Lights.

BRYAN. O., Sept. 19, 1888.

EDITOR ENGINEERING NEWS:

A collision occurred here this morning at 4 A. M. on the Cincinnati, Jackson and Mackinaw Railroad, caused by an open switch and no switch lights. There is a Y at this place for turning engines and trains. A passenger train was lying on the Y as shown in plan.

A fast express came from the south and the switch



being open (some one's carelessness) a head collision occurred. Both engines were disabled, the one coming in being wrecked. The baggage car in the yard was thrown from the track. The train was slacking up as they make a stop at Bryan (County seat, Pop. 4,000) and also take water.

Fortunately no one was injured. The road was built last year, and they have been running regular trains since last November, yet not a single switch light has been used, and the switches are left most of the time without locks. J. C

The Alley Elevated Railway—Correction.

Rapid Transit and Bridge Cons. Co.
15 Broad St., NEW, YORK, Oct. 2, 1888.

EDITOR ENGINEERING NEWS:

I beg to correct the statement in your last issue that the "Alley Elevated Road" has forfeited to the city the $100,000 deposited by it. By the terms of its contract with the city, the $100,000 will not be forfeited to the city, unless the company fails to build one mile of road in two years from the time of the deposit, which was made on the 19th of last July. The building of this road will be pushed as rapidly as possible. The engineers have been at work some time and are in charge of Mr. GEORGE B. CORNELL, late of the Union Elevated of Brooklyn, who has accepted the chief engineership of this road, and is now in Chicago in charge of their work.

Yours very respectfully,
A. F. WALCOTT, *Vice President.*

Formula for Bridge Members in Compression.

BY ALFRED D. OTTEWELL.

In an article on "The New Method of Dimensioning" published in the issue of this Journal dated June 11, 1887, the writer proposed for a particular case, the adoption of a straight line formula instead of the curved line formula of RANKINE; the straight line being tangent to RANKINE'S curve at the point of inflexion. The use of such a straight line may be advantageously extended to strut formulæ, as it will save much labor to the calculating engineer, when tables are not on hand, and deviates an inappreciable amount within practical limits from the curved line of RANKINE, which many of our bridge companies and railroads still adopt in their bridge specifications because of precedent.

RANKINE'S formula for wrought-iron struts is of the form

$$P = \frac{a}{1 + \frac{x^2}{b}} \qquad (1)$$

where P is the stress per square inch, a and b, are constants, and $x = \frac{l}{r}$ = the length of the strut (l) in inches, divided by the least radius of gyration (r) in inches.

$$\text{now } \frac{d\,P}{d\,x} = -\frac{2\,a}{b} \cdot \frac{x}{\left(1 + \frac{x^2}{b}\right)^2}, \qquad (2)$$

$$\text{and } \frac{d^2\,P}{d\,x^2} = -\frac{2\,a}{b} \cdot \frac{1 - 3\frac{x^2}{b}}{\left(1 + \frac{x^2}{b}\right)^3}, \qquad (3)$$

equating $\frac{d^2P}{d\,x^2}$ to zero, we have the point of inflexion at

$$x^1 = \sqrt{\frac{b}{3}} \text{ and } P^1 = \frac{3\,a}{4}.$$

Substituting these values of x^1 and P^1 in (2) we have

$$\frac{d\,P^1}{d\,x_4^1} = -\frac{3\,a\sqrt{3}}{8\sqrt{b}}. \qquad (4)$$

Now the general equation of the straight line tangential to the curve at this point is

$$P - P^1 = \frac{d\,P^1}{d\,x^1}\,(x - x^1) \qquad (5)$$

which by substitution reduces to

$$P = 1.125\,a - \frac{.65\,a}{\sqrt{b}} \cdot \frac{l}{r} \qquad (6)$$

From this formula may be obtained, by substitution, the straight line which is most nearly equivalent to any particular form of Rankine's curve. Some of the best known forms are given below, together with their equivalent straight line formula.

In these formulæ

P = the allowed compression per square inch of cross-section.
l = the unsupported length of compression member in *inches*.
L = the unsupported length of compression member in *feet*.
r = the least radius of gyration of the section in inches.
b = width of flange in inches.

Curve Formulæ	*Equivalent Straight Line Formulæ.*
$P = \frac{8000}{1 + \frac{l^2}{36000\,r^2}}$	$P = 9000 - 330\frac{L}{r}$
$P = \frac{8000}{1 + \frac{l^2}{24000\,r^2}}$	$P = 9000 - 400\frac{L}{r}$
$P = \frac{8000}{1 + \frac{l^2}{18000\,r^2}}$	$P = 9000 - 470\frac{L}{r}$
$P = \frac{8000}{1 + \frac{l^2}{40000\,r^2}}$	$P = 9000 - 310\frac{L}{r}$
$P = \frac{8000}{1 + \frac{l^2}{30000\,r^2}}$	$P = 9000 - 360\frac{L}{r}$
$P = \frac{8000}{1 + \frac{l^2}{20000\,r^2}}$	$P = 9000 - 440\frac{L}{r}$
$P = \frac{10000}{1 + \frac{l^2}{30000\,r^2}}$	$P = 11250 - 450\frac{L}{r}$
$P = \frac{9000}{1 + \frac{l^2}{5000\,b^2}}$	$P = 10125 - 990\frac{L}{b}$
$P = \frac{8000}{1 + \frac{l^2}{5000\,b^2}}$	$P = 9000 - 880\frac{L}{b}$
$P = \frac{7500}{1 + \frac{l^2}{5000\,b^2}}$	$P = 8440 - 830\frac{L}{b}$
$P = \frac{8500}{1 + \frac{l^2}{5000\,b^2}}$	$P = 9560 - 940\frac{L}{b}$
$P = \frac{10500}{1 + \frac{l^2}{5000\,b^2}}$	$P = 11800 - 1160\frac{L}{b}$

The following three examples will show that the straight line is as accurate, compared with Rankine, as an engineer ever wishes to attain:

I. $\frac{l}{r} = 40$ $P = \frac{10000}{1 + \frac{1600}{30000}} = \frac{10000}{1.05325} = 9500$ (curved line)

$P = 11250 - 1500 = 9750$ (straight line)

II. $\frac{l}{r} = 100$ $P = \frac{10000}{1 + \frac{10000}{30000}} = 7500$ (curved line)

$P = 11250 - 3750 = 7500$ (straight line)

III. $\frac{l}{r} = 140$ $P = \frac{10000}{1 + \frac{19600}{30000}} = \frac{10000}{1.6533} = 6050$ (curved line)

$P = 11250 - 5250 = 6000$ (straight line)

The difference in labor is also indicated.

Gravel Roads in Illinois.

A few years ago the Board of Trustees of the village of Saybrook, Ill., came to the conclusion that graveling their streets would greatly improve them, and also save the expense of the yearly road working. The gravel was to be had in great abundance from the Sangamon river which flows through the outskirts of the village. So they had about 8 ins. of gravel and sand put on to the principal street as an improvement. It proved to be a perfect success, as in the muddiest and wettest weather this road was as smooth as a floor. Gradually other streets were given a coating of gravel, and now every street in the village is graveled, and no matter what the weather is, the roads in Saybrook are always perfect.

The Highway Commissioners of the township, seeing the advantage that these roads were to Saybrook, determined to have some too, and now every road leading out from that village is graveled for one mile. At the town meeting this spring about $1,000 was voted to continue the system. It is estimated that this will build 1¼ miles of road. The road-bed is first prepared with scrapers and tile placed along the road-side wherever there is any standing water, and then from 8 to 10 ins. of gravel and sand are hauled on, and, when leveled, the road is good for 50 years, wear and tear, with only very slight and occasional repairs. Gibson, Lexington, Towanda, and Money Creek all have some graveled roads, and are extending the system as rapidly as possible.

LAKE MŒRIS.—Mr. COPE WHITEHOUSE, with whom many of our readers are familiar from his earnest work on the proposed impounding of the waters of the Nile in Lake Mœris, has again read a paper upon this subject before the British Association. The problem has evidently been more carefully worked out than when it was at first presented, and the question of cost, capacity, evaporations, etc; have been solved to the general satisfaction of the members of the Association present. As now proposed, his large basin would store about 26,000 millions of cubic metres of water, which when utilized at time of "low Nile", would return a thousand fold to Egypt all that this scheme would cost.

THE contract between the Northern Pacific Railroad Company and the Provincial Government of Manitoba was formally proclaimed at Winnipeg on Oct. 3, and the Northern Pacific & Manitoba Co., was organized with the following officers: JAS. McNAUGHT, President; J. W. HENDRICKS and Hon. JOS. MARTIN, Vice Presidents, J. M. GRAHAM, General Manager. The company will start regular train service from Winnipeg south by Oct., 10. over the Red River Valley Railroad.

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D. McN. STAUFFER, A. M. WELLINGTON. EDITORS.

GEO. H. FROST. - - - - - BUSINESS MANAGER.

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Drawings for publication *should preferably be in plain black and white, considerably larger than they are expected to appear, with letters and figures in pencil only, all lines clean and bold.*

Coming Technical Meetings.

Engineers' Club, Philadelphia, Pa.—Regular meeting Oct. 6. Secy., Howard Murphy, 1122 Girard St.

Civil Engineers' Club of Cleveland, O.—Regular meeting Oct. 9. Report on Civil Engineering. Secy., James Ritchie, Case Library Rooms.

American Society of Mechanical Engineers.—Convention and annual meeting at Scranton, Pa.; beginning Oct. 15. Secy., F. R. Hutton, 280 Broadway, New York.

Engineers' Society of Western Pennsylvania, Pittsburg, Pa.—Regular meeting, Oct. 16. Secy., S. M. Wickersham, Penn Building.

Boston Society of Civil Engineers, Boston, Mass.—Regular meeting, Oct 17.. Secy., S. E. Tinkham, City Hall.

American Society of Civil Engineers, New York.—Regular meeting, Oct. 17. Secy., John Bogart, 127 E. 23d St.

American Street Railway Association. — Next meeting at Washington, D. C.; Oct. 17. Secy., W. J. Richardson, Brooklyn, N. Y.

Civil Engineers' Society of St. Paul, Minn. — Regular meeting Nov. 5. Secy., Geo. L. Wilson, City Hall.

Engineers' Club of Kansas City, Mo.—Regular meeting, Nov. 5. "Electrical Railway", T. F. Wynne. Secy., Kenneth Allen, Y.M. C. A. Building.

WE have private advices in regard to a large tunnel contract abroad, under financial conditions which are reported to us as entirely satisfactory, which would seem to offer a very desirable opportunity for an American contractor of large experience and large capital. To any such person we shall be glad to give further details, and to put them in communication with the principals in this matter. No contractors not coming under the specified conditions would be likely to find the subject worth their attention.

THE finding of the Board of Engineers appointed in March last to consider and report on the plans prepared for the Quaker Bridge dam, has been adverse to them and in favor of a curved dam, with a radius of 1,146 ft., instead of a straight one, on the ground both of strength and appearance, thus confirming precisely the views expressed by this journal in its issues of Feb. 4-11, which we may perhaps fairly assume were largely instrumental in leading to the formation of the Board.

While we have never been able to feel any doubt that this would be the view of any competent Board, who should consider all the facts which had been brought out by the discussion, we are naturally gratified to find that our expectations have been confirmed, for we must confess that we felt some hesitation in expressing dissent from conclusions which were based upon such a long period of study and such extended collections of the facts in regard to other dams. It was only because the conclusions did not seem to us at all in accord with past practice, nor the technical argument in favor of them at all conclusive or even tenable, that we felt warranted in doing so. Holding these views, however, it was not consistent with our ideas of the proper functions of an engineering journal not to freely express them, even at the risk of being shown afterwards to be wrong.

What the recommendations are in regard to the section or profile of the dam we are not now advised, for the report has not yet been made public. As soon as it is we shall lay the essential parts of it before our readers. We cannot doubt, however, that considerable modifications are suggested, tending to equalize the very unequal factors of safety at different points of the total height, which makes the part of the dam 60 to 70 ft. below water considerably weaker than it is either above or below, thus tending to concentrate all vibration and elastic yielding at this point, and at the same time injuring the appearance of the dam from the front. But in saying this we would not be understood as failing to recognize the ability and care with which many details of the problem have been studied out, nor to overlook the fact that the dam was in many ways quite a new engineering problem, in the first attempt to solve which some errors might naturally be expected.

WE give in another column all but a small portion of a very admirable and practical paper by Mr. B. F. STEPHENS, C. E. on "Stand Pipes." The paper is accompanied by a table even more valuable than the paper itself, giving detailed information in regard to all the stand-pipes of which he could obtain record, 282 in number. Our own records, which will appear shortly in our "Manual of American Water-Works", cover a considerably larger number than this, so that the table is not entirely complete, but it goes into much more detail about the construction and proportion of the towers than the plan of our "Manual" permitted. We postpone the presentation of this table, however, in order to rearrange it. This is a busy age, and few will take the trouble to get all the good they might out of the most complete information when it is not so arranged that they can absorb it with minimum labor. Therefore, while we do not expect nor intend to add much to the very complete information of Mr. STEPHEN'S paper, we thought our readers would prefer to wait a week and have it in the best possible shape for their digestion.

THE abatement of the yellow fever panic in the South and the removal of the quarantine regulations has permitted the resumption of the regular passenger traffic on all railways outside the State of Florida. The railroad managers and employees in the South deserve great credit for their behavior during the serious times of the past month; and the liberality of the railroad companies in furnishing free transportation to refugees from the infected cities, who were unable to pay their fare to points of safety farther north, should have a wide publicity. "Soulless Monopolies" are very frequently managed by men with larger hearts and a juster appreciation of their duties to their fellow men than is possessed by those who delight to pose as public benefactors.

A CORRESPONDENT asks our opinion on the value of the following recommendation concerning the maintenance of street pavements, as embodied in the report of Messrs. GILLMORE, GREENE and NORTH to the City of Philadelphia in 1884, and especially if such a guarantee is a wise and judicious provision in city paving contracts in the light of experience :—

"All contracts for pavement (exclusive of macadam) should contain a clause by which the contractor guarantees to keep the pavement in good repair for a period of not less than 5 years from the date of its acceptance by the city; and to ensure a compliance with this guarantee the city should retain 10 per centum of its cost until the expiration of the 5 years term."

A provision at least similar to this is now very generally introduced into contracts for street pavements of the better class, and experience would seem to indicate that it is a judicious precaution. Its initial purpose is to guarantee as well as possible the close personal supervision of the contractor, and good work under the contract. The penalty is the increased expense of remedying any bad work found within 5 years, and the money to pay for this extra work is retained for this period from the original sum due to the contractor. It is an incentive to ask an increased price for the pavement in the first place, as an insurance for the contractor himself against undetected carelessness on the part of his workmen; and his price should justly cover a certain interest on the amount withheld. But as any bad work should be at once made good by either the corporation or the contractor, it is reasonable to suppose that the latter can do this work cheaper than the city, and the city can economically pay the higher price, as it includes a guarantee. The amount retained should, in our opinion, be regulated by the character and extent of the work; but a deposit of this kind is usually essential to secure the working of the guarantee. If properly appreciated at the start and carried out in a spirit of common justice, such a guarantee and security is both proper and wise.

AT a late meeting of the New York County Medical Society, Mr. JOHN R. BARTLETT again raised the question of "An Additional Water Supply to New York City; Independent of the Croton Watershed." It is the old Ramapo water supply project, obtaining the water from the Passaic watershed in New Jersey, with the additional feature of an entrance into New York by way of the Hudson River tunnel. The one serious and important question not discussed was the consent of the State of New Jersey to the diversion into another State of so large a quantity of the fluid so badly needed for cities within its own borders and depending greatly upon the Passaic and its watershed for any increased future supply. This water is State property, and the consent of the State has neither been asked or secured, as far as we can learn. The Hudson River tunnel is also by no means an established fact as yet; and judging from certain rumors in the air, the late English syndicate that were to push it through have halted from some cause in their preliminary labors.

WE regret to learn that the grand project for a union terminal company at Buffalo, under which all the tracks of the dozen or so different companies entering Buffalo were to be pooled and rearranged to best accomodate the traffic as a whole with minimum trackage, has for the present at least fallen through, some of the companies refusing to come in. They should be compelled to come in by law. We fear the end will be an abandonment or botching of the grade crossing improvements.

IT may interest our readers who have not the advantage of having a complete file of this journal, and only a small fraction of them

can have that, to see what has been the comparative number of pages per annum which they have obtained in return for their subscription. Beginning with 1886 the total number of pages published in ENGINEERING NEWS has been:

In	1876	396 pages	In	1883	636 pages
"	1877	370 "	"	1884	642 "
"	1878	412 "	"	1885	832 "
"	1879	420 "	"	1886	848 "
"	1880	446 "	"	1887	904 "
"	1881	526 "	"	1888	1068 "
"	1882	450 "			

Next year the chances are that they will receive 1248 pages, or 24 pages per week, and this statement takes no account of the maps and other insets which now appear frequently in the paper, but which formerly were conspicuous for their absence. The number of reading pages could not have been thus increased, of course, had not the number of advertising pages and the length of the subscription list increased in still greater ratio; but we doubt if there are many instances on record of more rapid growth. We hope, however, that the future of the paper may show even greater improvement than the past in all that goes to make a worthy exponent of American Engineering.

Col. R. R. HAZARD, at the last meeting of the British Association, strongly advocated underground railway communication in great cities. He pictured an ideal system of subways made by cutting down the street from curb to curb to a depth of 12 ft. and replacing the material by 4 centrally placed subways, two inside for rapid transit and two outside for local trains, all trains to be operated by electric motors. And on either side he would place other subways or galleries to contain all pipes, wires, etc., of every description. Good streets could thus be undoubtedly maintained above such subways and there is everything to favor this scheme, saving its enormous first cost and the fact that people do prefer to ride in the open air whenever possible. There are also certain contingencies of cross-town streets that need rapid transit, that would make it necessary to depress these crossings at so great an outlay—if possible at all—that the construction would probably seriously interfere with the scheme as a commercial undertaking.

But at least it is time to carefully study the question of subways intended solely for the accommodation of the multitude of plant now buried in the main streets of great cities, and as regularly being dug up and laid down again. Without being able to obtain the full statement of expenditure for all purposes and by all parties in the last ten years on Broadway, for example, it can be stated generally that parties concerned have from first to last paid for a very roomy and expensive subway. And the money has not only been spent, but the citizens have been, and are still being, constantly annoyed and seriously inconvenienced by the work going on before their doors and along the main thoroughfare of the city. The city on its part has spent a very considerable sum in paving and repaving, with the result of still having a shockingly bad street surface. Great and rich as is the city of New York, it has not and never had a thoroughfare fit to drive upon from the Battery to Central Park; such a roadbed, for example, as greater London everywhere maintains in and through the heart of its busiest sections. We ought to have one such sub-wayed main artery of travel, at least, running through the length of the city. And if it is thought that heavy teaming will make the maintenance of a good, smooth street surface too expensive, let us have another one specially prepared for heavy hauling and keep the teams upon it.

All this would cost money; but it would seem to be wise to rather expend a very large sum at once with the certain prospect of a definite improvement and lighter future maintenance expenses, than to spend an equally great sum in constantly digging ditches in our streets and filling them up again, with the result of doing the same class of work over and over again and never having even a decently paved surface three months at a time. Under present conditions there is no encouragement to construct good streets to start with, and apparently little incentive to keep the pavement we have in even passable condition. New York, as the chief city in the United States, should set the example to its sister cities by abandoning the methods of a generation ago and inaugurating a new system of main street construction, somewhat nearer the methods of great cities in Europe than is the present hand-to-mouth practice.

Tunnel Excavation on the New Croton Aqueduct.

In a rock tunnel thirty miles long the question of what constitutes the area for which the contractor can expect payment is a very important one to him; and on the New Croton Aqueduct this issue has assumed complex proportions, as are indicated in the letter published this week from a member of one of the contracting firms interested. The Aqueduct contracts and specifications are unusually rigid in their clauses governing the points at issue, and taken as they stand furnish cause for a difference of opinion with our correspondent, whatever we may think of the equity of the case.

The contract and the specifications covering the disputed points are as follows:

"(17) The form and area of the cross-section of the tunnel excavation at any place shall be such as the Engineer may determine for that place; but at all points it shall have an area of at least 201 sq. ft.

"Various forms of cross-sections of the tunnel excavation are illustrated on sheets Nos. 8½, 9½ and 16 of the plans. On the plans the line limiting the cross-section of the tunnel excavation is designated by the letters *A A A*."

The plans referred to represent imaginary cross-sections through various classes of material and with certain types of cross-section, viz.; circular or horse-shoe, timbered or untimbered, etc. The question in dispute is whether this line *A A A*, encloses all of the excavation for which the contractor can claim pay; or, whether it is simply a limiting line, showing the minimum area of rock excavation necessary for the purposes of the tunnel, and intended as a general guide to the contractor in placing his drill-holes and carrying out his work as economically as possible.

Clause 21 of the same specifications states that:

"No payment will be made for any excavation outside of the cross-section of the tunnel excavation determined by the Engineer; but all loose or shaky rock must be removed.

"The price per cubic yard, stipulated herein for tunnel excavation, is to cover all expense due to the presence of quicksand or other soft material, rotten rock, boulders, etc.; the cost of pumping and bailing; of all timbering and removal of the same; of removing all excavated materials; of all ventilation; and of all other work incident to the excavation of the tunnel. Any expense that may arise from loose and shaky rock or from falls or cave-ins, or from unexpected obstacles, shall be borne by the contractor.

Clause 25 imposes a penalty upon the contractor for the use of too high explosives, bad location of drill-holes, defective arrangement of timber, or any want of skill and attention, by giving the Engineer power to compel him to fill up at his own expense any such excess of area with masonry or other such material as he—the Engineer—shall direct.

The contract defines the duties and power of the Engineer as follows:

"To prevent all disputes and litigations, it is further agreed by and between the parties to this contract, that the Engineer shall in all cases determine the amount or the quantity of the several kinds of work which are to be paid for under this contract, and he shall determine all questions in relation to said work and the construction thereof, and he shall in all cases decide every question which may arise relative to the execution of this contract on the part of the said contractor, and his estimate and decision shall be final and conclusive upon said contractor."

The clause 17, referred to in the letter quoted by our correspondent, certainly gives the Engineer the right to decide upon "the form and area of the cross-section of the tunnel excavation at any place." But as part of the tunnel is circular and part of it is of horse-shoe section and the masonry lining ranges from 12 to 24 ins. in thickness, this right of fixing the area for different sections of the tunnel was necessary and proper, and the purpose of reserving this power is evident. It is true that this clause might be construed to mean that the Engineer had the power to fix a cross-section at any point that would include a heavy fall or any other excess of excavation over the normal lines of the tunnel proper; and a special provision to this end would have been perhaps an equitable clause in this part of the specification to cover necessary work over which the contractor had no control. But unfortunately for the present dispute this clause is missing, and the intent seems to be plainly to limit the discretion of the Engineer to the form of cross-section and the area required by the purposes of the tunnel at any part of the aqueduct.

The second part of clause 21 distinctly states that "no payment will be made for any excavation outside of the cross-section of the tunnel excavation determined by the Engineer," and the closing sentence—"but all loose or shaky rock must be removed"—would go to prove that it was intended that the normal lines *A A A* limited the line of pay-work at that point.

The third part of the clause 21 is the stumbling block. This provision plainly, with almost brutal plainness, specifically includes in the price per cubic yard almost every contingency that would make necessary any excavation or rather removal of material from points outside the lines *A A A*. It includes quicksands, soft material, boulders, loose and shaky rock, falls or cave-ins and "unexpected obstacles" in the expense to be borne by the contractor. This is asking a man "to bid against the Almighty" with a vengeance; but it is the bond.

It can be said, however, that this clause invited a decidedly high price upon the area included within the normal lines; and the engineers evidently intended it to have this effect, for their estimate of the cost of tunnel excavation exceeded the average of all bids received, and greatly exceeded the price at which this part of the work was let, as will be shown later. Another reason for not measuring excavation outside of the lines *A A A*, may be found in the desire to reduce the amount of backing masonry, for which the City pays, to its least possible dimensions; if the contractor fully understood that any outside material was to be removed at his expense, it is natural to suppose that he would use every possible expedient to support a bad roof and to reduce the size of the hole; by so doing he would save money to the city in masonry, and the interests would be mutual between himself and the city in this direction. But the contractor, in this case, would be justified and only wise if he put a round price upon this backing masonry, to compensate in part for any extra expense in removing rock outside the lines. It is a significant fact that the contractors did exceed the engineer's esti-

mate for this class of masonry; the only case in which this excess happened.

In support of the intent of the contracts as we read them, it is only necessary to call attention to the contracts for Sections *A* and *B*, which differ essentially in several of the clauses of the specifications and are so plain that they certainly appear to leave no ground to question their meaning. In these contracts the "neat cross-section line" is exactly defined in feet and inches, that part of the tunnel being under pressure and circular. After defining this line, the specifications say (clause 22) —"The tunnel is to be excavated to the neat cross-section line given by the Engineer." "No payment will be made for any excavation outside of the *neat cross-section line*; and all loose and shaky rock must be removed." (Italics ours). The third sentence, relating to price per cubic yard, is exactly the same as the one quoted above for sections 4, 5, etc. These were the first contracts drawn up, and the succeeding ones would doubtless have been similar in form, had it not been that some parts were of circular and others of horse-shoe section and it was impossible to define the lines as exactly as on *A* and *B*; though an attempt was made to indicate what was intended by the typical cross-sections referred to as sheets Nos. 8½, 9½ and 16. As the same engineers drew up both of these contracts it is not reasonable to suppose that in treating of so important an item as the area of tunnel excavation they should have meant one thing for sections *A* and *B* and something else for the remainder of one and the same tunnel, with almost equal lengths of work to be done in each.

The clause of the contract quoted which makes the Engineer the judge in matters in dispute is a common clause in all contracts. It is intended to assist him in interpreting the contract and its specifications; but it gives him no power to change the intent and meaning of these specifications. The latter is a law binding on both parties.

The unfortunate practice of some contractors is to secure the work at the best possible price, and then to trust to Dame Fortune for some allowance that will widen their margin for profit. We do not say that the contractors interested in this issue took this view of the case; but their bids indicate that either they did not sufficiently study the specifications in all their stern possibilities, or they had some hope of this kind. In the "Reports of the Aqueduct Commissioners, 1883-87", will be found an analysis of bids received on the 8 sections covering the work of contractors who are parties to this dispute. This analysis shows that the engineer's estimate for "tunnel excavation" was $8.50 per cu. yd., the average of all the bids received was $7.92, and the work was let at an average of $6.74. The brick masonry was estimated at $13; it averaged $11.80 and was let at about $10.40. Concrete masonry, 5 to 1, was estimated at $6, averaged $5.80 and was let at $5.25. Concrete masonry, 3 to 1, was estimated at $7; it averaged $6.66 and was let at $5.97. The rubble masonry alone exceeded the engineer's estimate of $5 per yard, for while the average of all bids was $5.95, it was let for $5.20. It would thus appear that the successful bidders took the work at a price too low, under the wording of the specifications and the strict enforcement of this law. Higher bids would have been considered proper by the engineers themselves. It is not sufficient to claim that the accepted bids were good enough bids under ordinary conditions; for this was not an ordinary piece of work and the specifications under which it was to be carried out were extraordinarily rigid and severe. And the fact that nearly every bidder for the work put a heavier price upon the rubble masonry backing than the engineer had expected, goes to prove that they generally understood that they were not to have the rock outside the normal lines, and relied on the price of this refilling of voids for their profit.

A careful study of the contract and specifications as they stand seems to leave no other construction open than that we put upon them; the equity of the contract as between man and man is another thing. If it were possible to eliminate all politics and other elements of corrupt control from the execution of great public works, contracts could be drawn on quite a different basis; and in such a case, contractors would probably not be compelled to guess at possibilities concealed under hundreds of feet of rock and earth—and to pay for their blunder if they made a mistake in their guessing. But the letting of this Aqueduct and the expenditure of many millions of dollars upon it called for very careful work on the part of the engineers who drew up these contracts. The city had to be protected at any sacrifice of individual interests; and the framers of these documents would have simply invited a possible sacrifice of their own heads had they left in the hands of the Aqueduct engineers any great latitude of personal discretion in classifying work or fixing areas of payment. The present contracts seem safe in this respect; and while they may pinch the too-anxious or too-confiding bidder, it would be unjust to the other original bidders on this work to make any changes at this late date.

The Storage Reservoir Appropriation.

It would be difficult to exaggerate the possible future importance of the modest little appropriation of $100,000 included in the "Sundry Civil" bill which has just become a law, for a beginning on surveys to determine suitable sites for storage reservoirs "at the headwaters of the streams west of the 100th meridian." In itself it will barely make a good beginning even on the surveys, but Congress rarely puts its hand to the plow and turns back, and as the entire trans Mississippi region will be a unit in favor of having the surveys pushed to completion, we may be tolerably sure that this at least will be done.

The surveys once made, so that something like a general plan for the entire work of improving any of the large valleys can be formed, there should be no difficulty in arranging for the execution of the works, without resort to the very objectionable plan of having them executed by the General Government, or the only less objectionable plan of having the works undertaken by private companies for profit, assuming that to be possible, on the large scale which the works must necessarily have. The lands may be given to the several States on condition of their executing certain specified works, the whole to be done under Government supervision and in accordance with a uniform system. That the profits would be large in many States does not admit of doubt, but even if they were not, a bare return of the money invested, or even a good percentage of apparent loss, would still leave the investment a profitable one for the States, by the resulting increase of population and consequent increase in the prosperity of the entire State. It is possible that some Government guarantee, or even direct aid on a small scale, would prove necessary and desirable, and there would probably be small opposition to it, as the entire country would benefit indirectly by the works, but that there would be any difficulty in securing the execution of the works after a general plan has once been elaborated, without the general Government directly undertaking their construction, we do not believe.

Some idea of the benefits to be conferred upon the vast domain west of the 100th meridian (which is about the westerly limit of the ready cultivation of the soil by the natural water supply alone) by the establishment of reservoirs for irrigating purposes can be obtained from an estimate sent to Congress last summer by Director POWELL which we have in part previously summarized. He says that the region in which agriculture depends upon irrigation includes about four-tenths of the United States, not including Alaska. As estimated, the area of the arid region is about 1,400,000 sq. miles. Of this one-fifth is too rugged or too elevated to ever admit of cultivation. There remains about 1,000,000 sq. miles which needs only water to be productive. At the minimum price of $1.25 per acre this land has a valuation of $800,000,000. At $30 per acre, certainly a moderate estimate of its value when irrigated, it would be worth $19,200,000,000. In 1880 less than one per cent. of the arable portion of the west had been supplied with irrigation works, but the portion which had been so supplied would average considerably higher than $30 an acre. Director POWELL does not believe that, with the most elaborate works, the reclaimed area can amount to more than 20 per cent., but adds, on the other hand, that an estimate based on available data leads to the conclusion that when all the larger streams have been brought under control and the storage of water has been carried as far as it may be economically, there will be redeemed about 15 per cent. of the region, or about 150,000 sq. miles; the whole comprehending one-half of the land now cultivated in the United States, for it is to be remembered that even in our most fertile regions only a small fraction of the total agricultural area is as yet actually cultivated.

Thus, out of the total 3,019,050 sq. miles of the United States, exclusive of Alaska, there were in 1880, only 837,628 sq. miles cut up into farms, or about 27½ per cent. of the total area, and only 46.9 per cent. of this area, or 392,673 sq. miles was improved land, which is only 200 sq. miles more than the *entire* area of the New England and Middle States (including Maryland) and the Atlantic tier of States down to and including Georgia, amounting to only 13 per cent. of the entire area of the United States, and only about 28 or 29 per cent. of the entire area east of the 100th meridian, the whole of which may be classed as, in the broad sense, arable land, the area to be deducted because of mountains and swamps being a small fraction of the whole.

The 100th meridian likewise divides the area of the United States into two nearly equal areas, (99½° is about the central line) the eastern half being 90 per cent. arable and the western half being in still larger proportion non-arable without irrigation, yet fully two-thirds of it the best of land if it can be irrigated. Director POWELL's estimate that at least 15 per cent. of this area is potentially irrigable certainly seems reasonable, and it means not so very much less a proportion of "improved land" in this section than there is east of the Mississippi river. Most of the rest would then become highly valuable for stock raising, and we may well believe that the present rainfall of 10 to 15 ins. would be so increased or equalized as to enable many crops to be raised even on the non-irrigated area.

But there is still another side to this great project of almost equal importance. It is justly claimed that the development of irrigating along the base of the Rocky Mountains i

of double importance because of its influence on the agriculture of the lower Mississippi. To store up the waters of the Missouri and its main affluents for the purpose of irrigation, if done on a large scale, should assuredly have a marked effect in diminishing the floods of the lower Mississippi. The principal source of the sediment in the Mississippi is the Missouri river, and with the abolition of the Missouri flood the sedimentary load of the lower Mississippi would be diminished, and the scouring power of the less loaded floods from the Ohio and upper Mississippi might reasonably be expected to establish for the lower Mississippi a lower grade and a deeper channel. The benefit such a change in the channel of the great river would confer upon the Southern States can hardly be estimated. The Geological Survey estimates that for every acre reclaimed to agriculture in Montana, another acre will be reclaimed in Louisiana, and, without acceding to this perhaps too hopeful view, the effect should certainly be very important.

The delay in passing the Sundry Civil appropriation bill has materially interfered with the plans respecting surveys for the establishment of reservoirs. If the appropriation had been made in time, it was proposed to send surveying parties to the headwaters of the Owens, Carson and Walker rivers, in the Sierra Nevada Mountains of California, debouching into the arid lands of Nevada, from there extending surveys to the headwaters of the Platte and Arkansas Rivers. It is probable now that surveys will be begun on streams in Southern California and Arizona, where the winter climate is mild. But where the beginning is made is of less importance than to make a beginning. The project is one deserving of every encouragement, only, the surveys should at an early stage be put under the control of practical engineers experienced in irrigation, and so be brought down to a definite basis in dollars and cents as early as possible. Each water shed can and should be studied by itself, and definite plans showing exactly what can be done with one of them presented, without waiting to finish the whole continent first.

The Kutter Fund.

As promised some weeks ago when the fund so generously contributed by the American friends of the late Mr. KUTTER was transmitted to his widow, we can now publish her reply conveying to her American friends the heartfelt thanks of one who was in distress. To ensure its safety in transmission, and to enable the Swiss associates of Mr. KUTTER to assist with their counsel in the disposition of this fund so that it would best carry out the wishes of the donors, the money was sent to the President of the Swiss Society of Civil Engineers, and he was given the power, with the advice of the governing council of that Society, to either invest it for the benefit of the widow and children of Mr. KUTTER, or to hand it over to her outright. The Society has seen fit to do the latter, as is shown in the following letter just received from Mrs. KUTTER:—

VINELZ near Elach, Switzerland, Sept. 18, 1888.
EDITOR ENGINEERING NEWS:

DEAR SIR:—As I promised, I gladly do now acknowledge the receipt of the whole sum, 4,550.75 francs, which my dear American friends have sent to me, and on which, I am convinced, will lay a special blessing as long as I live.

May God grant a rich reward to every one of you, is my wish and my prayer. Yours very gratefully,

M. KUTTER.

In a previous letter, of Sept. 10, in which she acknowledged the receipt of a letter notifying her of the source through which the fund was transmitted, Mrs. KUTTER expresses at greater length her joy and gratitude to the American engineers who have so handsomely recognized the services of her late husband. We can only repeat the words of the letter above and hope that each contributor will find his reward in the performance of a good deed; as they doubtless will.

PERSONAL.

THE Board of Regents of West Virginia University at their annual meeting in June, 1888, elected T. M. JACKSON, C. E., of Clarksburg, W. Va., Professor of Civil and Mining Engineering, and directed that a course of study for the degree of Civil Engineer be prepared and announced for the beginning of the Fall term, 1888.

T. WILLIAM HARRIS of the firm T. William Harris & Co., 44 Broadway, N. Y., was elected, Sept. 22nd, Secretary of the Pomeroy, Middleport and Syracuse Street Railway Co. This road will extend from Middleport to Syracuse, Ohio, a distance of over ten miles, and will be built in a most thorough manner for its large freight and passenger business.

WILLIAM H. LANE, of Lane Bros., Bridge Builders, Newark, O., died at his residence in that city Aug. 18. In a circular dated Sept. 28 the Lane Bros. Bridge & Construction Co., of Newark, O., announce that they assume all debts and obligations of the former firm and will carry out all contracts made by it.

CHAS. S. CHURCHILL has given up the Chief Engineership of the West Virginia & Ironton Railroad, a branch of the Norfolk & Western system now being located from McDowell county, W. Va., to near Ironton, O., to accept the position of Engineer of Maintenance of Way, Norfolk & Western Railroad, with headquarters at Roanoke, Va. C. C. WENTWORTH, Principal Assistant Engineer, Norfolk & Western Railroad, will have charge of the surveys on the West Virginia & Ironton Railroad during the winter.

The Manchester (England) Sewage Scheme.

A scheme for sewage disposal for Manchester, England, designed by City Surveyer JOHN ALLISON and approved by the Rivers Committee of the Manchester Corporation, is now being examined by Mr. S. J. SMITH, Inspector for the Local Government Board.

At present the City of Manchester discharges its sewage into the rivers Irwell, Irk and Medlock; but owing to the enforcement of the Rivers Pollution Act by the Salford Corporation on the one hand, and by the construction of the Manchester Ship Canal on the other, it has become imperative that this sewage be collected and purified before it is allowed to pass into these streams.

The area of the municipality of Manchester is 5929 acres and comprises a population of 378,000. The average water consumption is only 13 galls. per head daily, as there are only 18,800 water closets in the city. But in addition to the Corporation water supply, 5 galls. per head are obtained from other sources, so that the real average consumption is 23 galls. per head; and with a population of 400,000 this would mean a daily dry weather flow of 10,000,000 galls. As a new water supply is being built and the consumption will probably increase, the works are designed for a daily use of 44 galls. per head. The Manchester rainfall is 35 in. per year, and to provide for a certain amount of storm water, the present scheme is based upon a maximum flow of 100,257,000 galls. in 24 hours.

The plan adopted consists of a system of intercepting and outfall sewers, dividing the city into convenient drainage areas, with a main sewer of sufficient capacity to each section. There are no special engineering features connected with this part of the work. The gradient of the sewers in the city varies from 1 in 18 (for a short distance) to 1 in 1160. The sewer into which all the others converge beyond the city limits is 14 × 10.6 ft. and has a gradient of 1 in 2640: it is calculated to pass 21,849 cu. ft. per minute, or double the maximum capacity required. A storm overflow on this line discharges into the Irwell any excess over 40,000,000 galls. per day.

The trunk sewer terminates in a main outfall sewer, 10 ft. in diameter, with a gradient of 1 in 2640 and capable of conveying a flow of 130,000,000 galls. per day. This sewer is between 4 and 5 miles long and terminates at the precipitation works: it crosses the existing Trafford sewer by a syphon pipe of iron and passes twice under the Bridgewater canal by iron pipes of full diameter of the sewer and in 9 ft. lengths. At another place it is flattened into an iron tube 12½ × 8 ft.

The precipitation works cover 95 acres on the river Irwell with wharfage for the removal of sludge. The precipitation is conducted in 20 tanks, each 100 × 60 ft. and 7 ft. deep near the entrance and 5 ft. near the exit. The tanks will be made of concrete with either vertical or sloping sides. The total capacity of the tanks is 4,500,000 galls. The sill of each of the series of ten tanks is 2 in. lower than the one back of it so that a continuous flow of about 7 ins. per minute is obtained. While the tanks are so arranged that the sewage can flow through the whole series, it is expected that only ten need be used at one time; or each series can be used independently and together. As the sewage reaches the works, it enters a special chamber in which the heavier impurities are deposited. After this it passes through a screen which intercepts the flocculent matter, which with the heavier material first caught is removed by special appliances. After passing the screen the sewage is mixed with a certain volume of lime and alum, and, after agitation, the whole of the liquid passes into a chamber 188 ft. long, from which it flows into the first series of tanks.

It is calculated that the sludge will require removal from the first tanks every day and from the others at longer intervals, not exceeding six days. The sludge is emptied as follows: The sill is so arranged between each tank that by lifting sluice boards at one side a channel is formed. When it is desired to shut off one tank, the sewage is carried along this channel and down each side of the tank to the sill of the next tank and over this in the usual way. About 6 ins. above the level of the sludge a valve is fixed, which closes the opening of a pipe passing through the side of the tank into a pipe fixed in a central conduit running between each series of ten tanks, and thence to a well, called the effluent water well, from which it is raised by a pump and again passed through the tanks. After the liquid sewage in the tank has drained off, a second and lower valve is opened and the sludge is allowed to pass through a second pipe into the sludge well, whence it is raised by pumps and deposited on land especially prepared. The daily bulk of sludge is estimated at 120 tons, and when it is raised it contains much moisture, so much so that in four days this 120 tons will dry down to 25 tons containing about 47 per cent. of moisture.

Dr. FRANKLAND estimates that 95 per cent. of the polluted matter will be deposited as sludge, and he thinks that the effluent leaving the tanks in winter will need no further purification. But in addition to the tanks the remaining 63 acres of ground will be laid out in plots of six acres each as filter beds to be used intermittently in summer.

The estimated cost of the whole scheme is $2,250,000 for sewers and works, and $200,000 additional for land. The estimated flow of the Irwell river, or Ship Canal as it will be, is at this point 162,000,000 galls. daily, with a present dry weather flow of sewage of 10,600,000 galls. daily. As the Local Government Board permits a ratio of 1 in 8 in sewage discharge, even the 16½ million galls. daily of sewage to be eventually treated will still be within the mark.

Stand Pipes for Water-Works.*

In the United States there are as far as known 282 stand-pipes and tanks used for water-works. A stand-pipe elevated on a hill, or trestle, or tower, may store more water and perhaps be a more economical plant, where high service is the rule, if always kept filled; but if the object be to satisfy domestic purposes at a reduced head and at the same time conditioned so as to promptly respond for fire pressure, then, I take it, the tall stand-pipe of small diameter is the most economical and effective. To serve a town of 10,000 and upwards there is economy in the long run to run continuously with an open stand-pipe of water to cushion against, rather than the direct pressure system.

Some may say, "the lower half of a stand-pipe is of little practical value." It is a very economical ballast.

The stability of high stand-pipes, either with or without guys, introduces the subject of "resistance

*Slightly abbreviated from a valuable paper by Mr. B. F. STEPHENS read before the American Water-Works Association.

of wind-pressure." It is quite practicable to build a water tower 250 or 350 ft. high; but one's theories, however good, should as far as possible be put to practical tests. Engineers regarded as authorities and who have given stand-pipes much study, have decided views and some directly opposite. I am on the theory that they are self-supporting and maintain their position by their own inherent strength.

A FEW PRACTICAL SUGGESTIONS.

Where it is possible a stand-pipe should be near the pumps to prevent uneven pressure, pulsation and water ram. Their office is to take up the excess of water and compensate for the deficiency of delivery.

Bottoms.—In structural stand-pipe work I do not favor cast-iron bottoms, or steel bottoms, or steel angle iron, or steel rivets.

Brackets.—Wrought-iron bottoms with brackets riveted to the outside lower courses reaching up to the second or third sheet should form the base. Brackets may be bolted to and through foundation. Brackets give larger base area and are additional security against wind pressure. The bottom and first course should be made up with a ring of angle iron.

Plate.—The best width of plate is what will practically build 5 ft. Thickness of iron and length of plate should vary according to height and diameter, always keeping the prospective *future* in view of the probable need of addition to height.

Holes.—Holes should be drilled and not punched. They should coincide or be absolutely true to each other so as to avoid the use of a drift pin. Where 3 plates join, the overlap must be scarfed down while hot so the plates will have a perfect and equal strain at all points. No fulling tool or fooling tool should be allowed at such places.

Manhole. — The manhole should be of wrought-iron with wrought flanges and plate, and its position most convenient at the side. (The cast iron manhole is always placed on the sheltered side, and must be covered or protected in winter with box or barrel filled with saw-dust or some non-conductor.)

In-flow Pipe.—The in-flow and out-flow pipe should be the one pipe where the demands will allow.

Overflow Pipe.—The interior of the upper part of a stand-pipe should be kept free and clear. *Inside* overflow pipes, ladders and braces are obstructions. Ice is their enemy.

Anchors.—Anchors and guys are unnecessary. As unpleasant, unsightly and useless as so much barbed wire in the field.

Material.—A stand-pipe should not be built on the economic plan. A careful examination of the table herewith appended [We omit this highly valuable table this week in order to rearrange and reclassify the pipes so as to make the statistics of the table more readily accessible.—Ed.] will convince the thoughtful. Let the material be first-class homogeneous iron, with a generous distribution of angle-iron correctly applied, and it will be found sufficiently strong to anchor itself whether empty or full, as well as to admit of aerial expansion and defy cyclone, tornado or wind-storm.

Height.—To-day several would gladly add to the height of the stand-pipe, but cannot owing to a low factor of safety. The only alternative is to raise and add to the bottom.

Cover.—A *cover* of galvanized iron, conical in shape, is unobjectionable, provided there is provision for a circulation of air underneath.

Freezing.—We know of wooden tanks exposed to 50° below 0, air-space above and below, made tight by grouting the floors, prevents freezing. Injected steam or heated pipe coil, or any application of heat underneath or felted exterior is needless. Frequent pumping at intervals of 8 to 10 hours into the stand-pipe, and letting out or changing the water on coldest days, is the sure, easy and economical preventative against freezing.

Felt Covering.—I had an experience with a stand-pipe 102 x 20 ft. A felt covering man, a come-when-you-are-away young man, in my absence, induced the executive committee to cover 8 ft. of the lower part, guaranteeing his felt covering would prevent freezing. They generously charged half the bill to me, which I paid under protest.

Paint.—An asphaltum paint is best. A preparation applied to the Painesville stand-pipe in 1882, stands to-day good as new. It does not crack in winter nor in summer. Color, steel blue.

Manhole.—The man-hole in the side, on the first course of plate, is generally provided for cleaning out purposes.

Sediment.—*Many* suppose that apparently brilliant and crystal clear water is without sediment, while others know that water pumped into a reservoir will precipitate more or less the particles held in suspension. The writer has discovered sediment a foot thick and more, deposited from purest looking water, being the accumulation of about a year. Its color was most black and foul. Oh! how much we keep secret in this life. What! one foot of sediment! Hush, quiet! Work rapidly for the water is off the town. The *fear* is a consumer discovering it and telling his neighbor.

Color.—I could amuse you quoting answers to questions under this head:

Louisville, Ky., answered that their sediment was "from a pale and melancholy yellow to a rich sunset red."

A large manufacturer of stand-pipes writes: "Stand-pipes are not cleaned out as often as they should be. The method is to empty the pipe; waste the water; take off the manhole, syphon out the water below the manhole plate and send men inside with shovels and scrubbing brushes to remove sediment and muddy bottom-water by hand, then rinse out, apply the manhole cover and fill her up again."

This operation costs loss of water, time, a new gasket, extra labor, and great inconvenience oftentimes to manufacturers and business interests.

Where direct pumping comes to the rescue during this interim, extra coal and skilled attendance is required and also what is equally costly, though unexpressed in dollars and cents, is the anxiety or fear of accident anywhere while the stand-pipe is dismantled and *the uncertainty of making the joint water-tight at the manhole plate*, and the possibility of damage from oscillation or overthrow by wind storm while the stand-pipe is not ballasted with water.

In 1883 the stand-pipe at Painesville, O., had a patented device applied, at a cost of $100, which operates successfully to cleanse it at pleasure *while the pipe is full of water*. After 5 years use I confidently recommend its utility and adoption as an effective, essential, sanitary adjunct for any stand-pipe. It consists simply of a sediment discharge pipe passing in through the side and terminating at or near the center and bottom, or where the dish is greatest, of the stand-pipe. When the valve in the sediment pipe is open, the column of water exerts the pressure and causes a rush of water through the discharge pipe with such force as to carry all the sedimentary matter and impurities away with it, and the reservoir is cleaned in from 5 to 10 minutes. Typhoid fever germs generate in sluggish bottoms.

DESTRUCTION OF STAND-PIPES.

The Lexington, Mo., stand-pipe collapsed June 22, 1885. Its situation was on highest elevation. On a foundation there were raised 6 cast-iron columns 40 ins. in diameter by 50 ft. in height. Upon these rested the stand-pipe 152 ft. high by 22 ft. diameter made of ¼ in. iron; capacity 365,000 galls. When full of water it *burst*, scattering the material as if by explosion. The city had been supplied for some weeks but had not accepted it.

Victoria, Texas, partial collapse. Size 100 ft. by 16 ft. 70 ft. ¼ in. iron; remaining 30 ft. $\frac{5}{16}$. When 70 ft. of water was in the pipe a cyclone or tornado wind of about 80 miles per hour caused an oscillation and swaying, then a buckling and collapse of the 30 ft. not filled with water.

Gravesend, N. Y., Oct. 7, 1886, burst. A total wreck.

Newport, Arkansas, Wooden tank; burst, great damage resulting.

Caldwell, Kansas, 1887; collapsed while building. 150 ft. by 12 ft. 6 in. The pipe was empty. It doubled over about midway, taking part of foundation like the uprooting of a tree.

Plattsmouth, Nebraska, March 1887. Partially collapsed by storm while empty.

Cincinnati, O. Burst; a total wreck. Steel too light.

Belleville, New Jersey, 100 ft. × 6 ft. × ¼-in. thick.

Franklin, Mass. Iron tank 30 ft. high by 35 ft. diam., contents 216,000 galls. burst at 3 A. M. Oct. 27, 1887. They undertook to raise it in the air 40 ft. and rest it on brick piers. The piers were green and they failed under the weight. The iron was badly torn. A total ruin.

Seneca Falls, N. Y., burst Oct. 27, 1887; size 120 ft. x 30 ft. A ¾ in. thick plate fractured. The cause was bad quality of the plate.

Thomasville, Georgia, collapsed Dec. 10, 1887, before completion. In the erection of the tower, scaffolding had been built so as to serve as a brace between the centre pier and outer walls. This pier was solid brick masonry of 6 ft. diameter. The hoisting of brick to top of tower swayed the pier out of plumb and caused its overthrow.

Houston, Texas, foundation settled. Made of brick and cement. A circular wall with cross sections was too slim a foundation to support a pipe of water 74 ft. × 20 ft.

Kankakee, Ill., collapsed, then blew over, breaking and taking out the hold down bolts. Material, steel, 120 ft. × 20 ft.

The Gravesend stand-pipe must receive a passing notice and I am done.

It was erected under contract for the "Kings County Water Supply Co.," at Gravesend, N. Y., by the "Robinson Boiler Works", Boston, Mass. On Oct. 7, 1886, while being filled with water, under direction of Mr. ROBINSON, it burst and fell, a total wreck. The pressure gauge at the works showed 102 lbs. This stand-pipe was circular, made of steel-plates 16 ft. diameter to a height of 70 ft. contracted at that point by a conical frustum 25 ft. high to a diameter of 8 ft., which it held to the top, for 155 ft. making a total of 250 ft. in height, bearing the proud position of being the tallest stand-pipe in the world.

The bottom plate was ⅜ in. steel, cut in quadrants and united with 5-in. lap-joints of 1-in. rivets staggered, and 17 ft. diameter. The foundation was 17 ft. deep; base, 33 ft. diameter at bottom, by 18 ft. at top; made of concrete rubble and broken stone. Lower half of Rosendale cement and upper part of Portland, surrounded by a concentric ring of brick masonry.

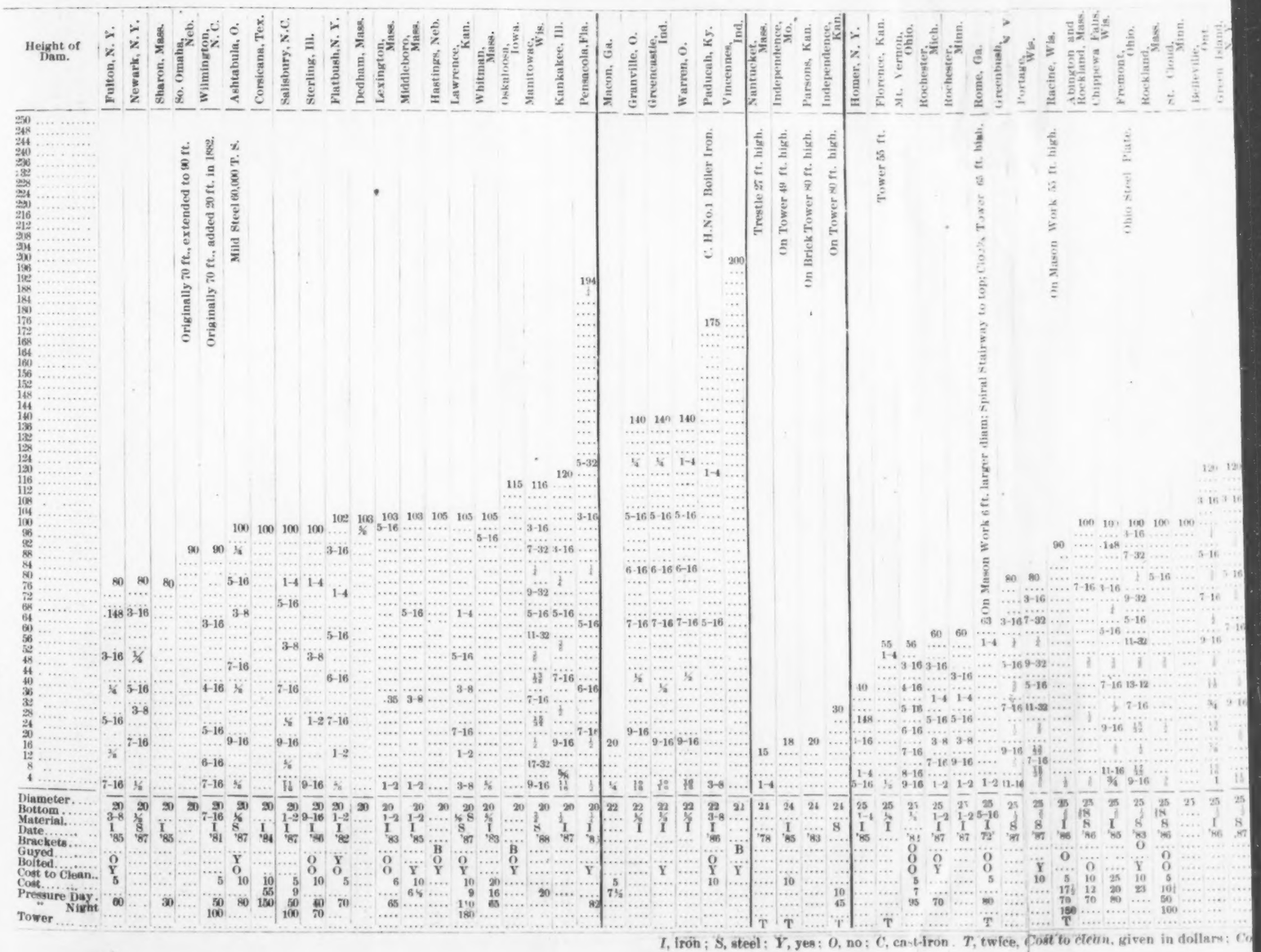
The steel plates made up 5 ft. from center to center throughout. There were 6 plates in the circle of 16 ft. diameter and 3 where it was 8 ft. The lower or first course of 5 ft. ⅜ steel was to be connected to bottom by 6×6×⅜-in. angle-iron; flanged, turned out. The next 30 ft. ¾-in.; then 15 ft. ⅝-in.; all made up with 3 rows rivets in vertical seam and 2 rows in the horizontal seams; next 20 ft. ⅝, making 70 ft. of 16 ft. diameter; then 25 ft. ⅝; taper from 16 to 8 ft.; then 5 ft. ⅝, first course above taper; 30 ft. ½; 35 ft. ⅝; 30 ft. °; 30 ft. ¼; 35 ft. $\frac{3}{16}$. All the plates were to be steel, stamped 60,000 T.S. All vertical and horizontal seams above the first 50 ft. double riveted with sufficient lap to make a good job.

On the outside were two balconies and the pipe ladder. Of the 12 guys—of 1-in. wire rope—6 were fastened to a welded collar 8x¾-in. secured 100 ft. from the bottom, and the circle of anchorage was 80 ft. from centre of base of tower: and 6 secured 225 ft. from bottom and anchored 150 ft. from centre of base. The points of anchorage in the two circles alternating. The guy anchors were 3½-in. iron rails, each imbedded in concrete 6x4x8 ft. deep.

The joining of the taper section with the verticals above and below frustum were strengthened and stiffened with 12 wrought 4x4 T irons. The 25 ft. of top was strengthened by 3x3 angle iron and a ring of angle iron at top.

The photographs herewith show the tower before and after the catastrophe, and serve to illustrate the theory of its destruction. At the 95 ft. level, or top of the frustum, the parting is complete around the circles and along the upper line of rivets. At the 60 ft. circle, or two sheets below the base of the frustum, the fracture was complete around the circle through the riveted section similar to the other. The frustum lay complete with two circles of plates of the 16 ft. cylinder attached to it, as shown in the photographs. The edge of the 60 ft. circle lay within a foot of the foundation. In very few cases are the rivets sheared or torn, and the bolts held to either one or the other broken parts. Seventy-two plates were represented below the 60 ft. level. These were shattered and scattered into 30 or 40 pieces. The largest, containing 15 plates, weighing about 7 tons, was flung 60 ft. northwest of the tower. The steel angle-iron that connected the base plate to the first course vertical was completely

The Stand-Pipes of the United States: their Heights, Dia



I, Iron; *S*, steel; *Y*, yes; *O*, no; *C*, cast-iron. *T*, twice. *Cost to clean*, given in dollars; *Co*

tates; their Heights, Diameters, Thickness, and other Details of Construct

	Mich.	Rochester, Minn.	Rome, Ga.	Greenbush, N. Y.	Portage, Wis.	Racine, Wis.	Abington and Rockland, Mass.	Chippewa Falls, Wis.	Fremont, Ohio.	Rockland, Mass.	St. Cloud, Minn.	Belleville, Ont.	Green Island, N. Y.	Atlantic City, N. J.	Massillon, Ohio.	Sandusky, Ohio.	Height of Dam.	Hoboken, N. J.	Seneca Falls, N. Y.	Savannah, Ga.	Brookline, Mass.	Woonsocket, R. I.	Baraboo, Wis.	White Plains, N. Y.	Westerly, R. I.	Newton, Kan.	Elgin, Ill.	Springfield, O.	Cornwall, Ont.	Houston, Tex.	Hopkinton, Mass.	Quincy, Mass.	Augusta, Ga.	Franklin, Mass.	Cannondale, Conn.
				On Mason Work 6 ft. larger diam;		On Mason Work 55 ft. high.			Ohio Steel Plate.								250	Brick Tower 150 ft. high; 30 ft. sq.								On Tower 44 ft. high.				Steel Brackets, 10 x 12 ft.			Trestle 84 ft.; Tank 37 ft. diam. by 20 ft. deep; Conical 10 ft. diam. by 35 high.		Brush Ot. 22,1887.	
				Spiral Stairway to top;													248																		
				Cl o.½ Tower 65 ft. high.													244																		
																	240																		
																	236																		
																	232																		
																229	228																		
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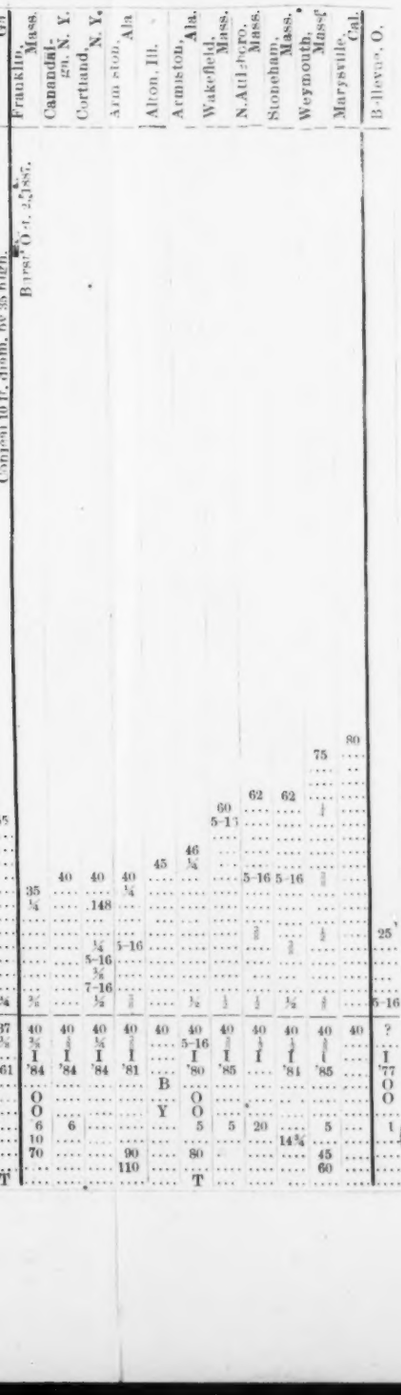
													120	120			116																		
												3-16			5-16		112												112						
													3-16				108																		
																	104																		
							100		100	100	100						100											3-16								
								100	3-16								96										95								
						90		148									92																		
									7-32			5-16			7-16		88											5-16							
																	84																		
																	80																		
							7-16	3-16									76									76									
				80	80												72																		
																	68																		
				3-16	3-16							7-16					64																		
																	60																		
				63	7-32								7-16				56																		
																	52																		
				1-4	½							9-16					48																		
																	44																		
				5-16	9-32										9-16		40																		40
																	36																		
				7-16	11-32												32																		
																	28																		
				9-16	5-8												24																		
																	20																		
					7-16												16																		
				11-16	13-32												12																		
																	8																		
																	4																		
																	Diameter.	30	30	30	30	30	30	50	30	30	30	30	30	30	35	35	37	40	40
																	Bottom																		
																	Material	I		I		I	I	I	3-4	½	I		S	I	I		I	I
																	Date	'82		'54	'88	'84	'87	'85	'86	'84		'82	'86	'85	'61	'84	'84
																	Brackets.	O									B		B					
																	Guyed	O												O			O	
																	Bolted	O												O			O	
																	Cost to clean	5				12			10				3				6	6
																	Cost.	4½			6½				85					6½	10		
																	Pressure Day.	42		50					90	44		70		60	70			
																	Night											90						
																	Tower.	T								T						T		

n. *T*, twice, *Cost to clean*, given in dollars; *Cost*, given in thousands of dollars.

struction.


Franklin, Mass.
Canandaigua, N. Y.
Cortland, N. Y.
Anniston, Ala
Alton, Ill.
Armiston, Ala.
Wakefield, Mass.
N. Attleboro, Mass.
Stoneham, Mass.
Weymouth, Mass.
Marysville, Cal.
Bellevue, O.
Contract to be finished Oct. 25, 1887.
Brass

Number Details of Construction, Classified, first in order of Diameters, and secondly in order of Heights.

Following paper by B. F. Stephens C. E., published in Engineering News of Oct. 6, 1888.]

Name of Town	Weight of Basin	Diameter	Material	Rivets	Pitch	Lap	Plates	Remarks
Maquoketa, Ia.								
Falls City, Neb.								
Pipe Stone, Minn								
Chillicothe, Mo.								
Concord, Kan.								
Menomonee, Wis.								
Pierce City, Mo.								
Freeport, Ill.								
Baton Rouge, La.								
Harper, Kan.								
Dallas, Tex.								
Selma, Ala.								
Denison, Texas.			Hammered Steel.					
Sedalia, Mo.								
Waterloo, N. Y.								
Sycamore, Ill.								
Crawfordsville, Ind.								
Bl'k Riv. Falls, Wis.								
Lincoln, Ill.								
Seguin, Tex.								
Victoria, Tex.								
Kinsley, Kan.			6 Heavy Wt. B.					
Mt. Vernon, Ind.								
Middletown, Pa.								
*Gravesend, N. Y.								
Charleston, S. C.								
Gloucester Cy, N. J.								
Lincoln, Neb.								
Brenham, Tex.								
Charlotte, N. C.								80 ft. high in 1882 and 30 ft. added in 1885.
Dayton, O.								On Tower of Brick 32 ft. high.
Aurora, Ill.								Bottom 2nd & 3rd 3 rivets.
Lansing, Mich.								
Yonkers, N. Y.								
Maryville, Mo.								
Lexington, Mo.								
Waterford, N. Y.								
Princeton, N. J.								On Trestle 60 ft. high, 32x18.
Wellington, Kan.								On Stone Tower 85 ft. high.
Cleburne, Tex.								
Beloit, Kan.								
Adams, N. Y.								
Houlton, Me.								
Perth Amboy, N. J.								
Coney Island, N. Y.								
Council Grove, Kan.								
Painesville, O.								
Alliance, O.								
Beaver Dam, Wis.								

(OVER)

torn off in the angle around the circle. The fractured surfaces of the steel, were scalloped or striated in form on the riveted lines, and this was true of almost all the fractured edges of the wreck.

There are two flaws to be seen in the fallen plates, one has been checked from spreading by rivets made up in the plates at each end of the scar. (This was undoubtedly done in cold blood to keep the fracture from spreading.) Another scar 6 ins. long extends from the edge of the plate in a zig-zag way into the plate. Marks of a caulking tool show on each side of it.

None of the guy ropes at the tower end were severed. Two iron rail anchors in the large circle to W. S. W. and S. S. W. were broken, and also one in the smaller circle west.

The events in this explosion were progressive. The tower was being filled by order of Mr. ROBINSON, and he was about to ascend in a cage on the outside to do some caulking. The water was within 10 ft., of the top. On examination I am convinced that the first burst occurred on the north side of the fourteenth course, which is one course below the base of the frustum at a height of 65 ft. This bursted plate shows distinct striation. It is laid open like a door on hinge standing half ajar. The fracture was on one plate from the end of the plate to one half its length. The rupture coursed along the inner rivet line on the vertical as well as along the upper and lower horizontal inner rivet lines.

A gushing, hissing noise followed the explosion, a surging crash, and all was over. The force of water through this aperture and against this half opened sheet, acted as a shaky rudder to give a centrifugal fling to the structure. Instantaneous vibration throughout shook it to its foundation, twisting the cylinder on a vertical axis, ripping the lower seams, rending the unhomogeneous plates into fragments, sending them to the positions they now occupy on the field. The entire upper part, above the 60 ft. circle, fell vertically, with a rotary movement from west to east, striking the bed plate on the north-east section and careened over, E. N. E., breaking or snapping off at the 95 ft. level on the rivet line, as before described, by the blow on the ground. The foundation remains intact. The elastic limit of a homogeneous steel was not passed.

Messrs. Schoenberger & Co., of Pittsburg, Pa., write me that: "they did not furnish all the sheet plates, and that it was not proper for the builder to put the brass plate reading, "Schoenberger & Co's steel, Pittsburg, Pa. Tensile strength 60,000 lbs. *on the stand-pipe.* The *quality* was *ordinary tank steel.* We always decline to put our name to ordinary tank steel, fearing that it might be used for boilers or purposes for which we would recommend a better grade. We never heard of a stand-pipe of such an extraordinary height as 250 ft."

In conclusion, assuming that the first rupture occurred in the first or lower ring, and the pressure 100 lbs. per sq. in., the strain on each inch of height of the plate would be

$$\frac{16 \text{ ft.} + 12 \text{ in.} + 100 \text{ lbs.}}{2} = 9{,}600 \text{ lbs.}$$

And this plate $\frac{7}{8}$ in. thick, would make the strain per square inch $= 9{,}600 \div \frac{7}{8} = 10{,}970$ lbs. The rivet pitch being $3\frac{1}{4}$ ins. and the rivets one in. makes the actual strain

$$10{,}970 \div \frac{3\frac{1}{4}}{2\frac{1}{4}} = 15{,}850 \text{ lbs.}$$

If the sheet metal was rolled cold, and if the holes were punched cold, these must have been elemcnts of weakness, and this weakness would increase with the thickness of the plates used. To illustrate, imagine a curved metal plate:

If this plate is thin the compression of the inside surface and the extension of the outside surface, when rolled will be little, but as we increase the compression and extension of the inside and outside parts, until with an exceedingly thick plate the inside would wrinkle or pucker, and the outside would crack open or become so weak from compression and extension that they would resist but little strain. Punching leaves the metal around the the hole in a strained state, therefore the only safeguard is to drill them. Close inspection is necessary to see that steel is homogeneous, fibrous and ductile. But until steel is made as ductile and fibrous and workable and sure as iron, it cannot be given preference to iron, or even considered as good for structural purposes.*

PUBLICATIONS RECEIVED.

Reports on the Water Power of the United States Part II. Contents:—"The Water Power of the Northwest", by JAMES L. GREENLEAF. "The Water Power of the Mississippi River and some of its Tributaries", by JAMES L. GREENLEAF. "The Water Power of the Region Tributary to the Mississippi River on the West, below Dubuque", by DWIGHT PORTER. "The Water Power of the Ohio River Basin and of the Ohio State Canals", by DWIGHT PORTER. "The Water Supply of Certain Cities and Towns of the United States", by WALTER G. ELLIOT.

This is the second part of the "Statistics of Power, and Machinery Employed in Manufactures" collected for the Tenth Census under Prof. W. P. TROWBRIDGE, as Chief Special Agent. The volume has over 600 quarto pages of matter, including numerous statistical tables, illustrations, etc. The first four reports treat of the systems and area of the drainage, topography and character of the country, character and distribution of the water powers, the geology of the region and flow and condition of the streams, etc. In each case the main powers are separately treated. The final report on water supply is useful for giving in a condensed shape the various methods of municipal water supply in American cities, together with many illustrations of plant and much historical data and detail. But as this report was handed in in 1882, the methods and the list of works given as in operation in the United States sorely need revision, as omitting perhaps 50 per cent. of those now supplying water, among others the New Croton Aqueduct, almost finished. The illustrations are small and are rarely accompanied by scale of dimensions; and are thus rather mere general records than otherwise.

Proceedings of the Association of Provincial Land Surveys of Ontario; at the 3rd annual meeting, held at Toronto, Feb. 28, 29 and March 1, 1888.

This publication contains the record of proceedings, reports from the officers and from the committees on Land Surveying, Registered Plans, Drainage, Legislation, Instruments, Etc.; also the address of President KIRKPATRICK, and the "Question Drawer." The following are the papers printed, with dicussions: "Practical Surveying", by A. NIVEN; "Formulæ for Finding the Time by Observations in the Vertical of Polaris" by E. DEVILLE; "Court Decisions on Drainage Cases", by W. R. BURKE and H. B. PROUDFOOT; "The Local Improvement Act", by W. M. DAVIS; "Highway Bridges", by A. W. CAMPBELL; "Hydraulics", by G. J. GALBRAITH; "Rolling Planimeter", by G. B. ABREY. There is also a biographical sketch, with portrait of the late ANDREW RUSSELL, who was for 54 years in the public service, and who introduced into Canada the use of the transit theodolite.

Annual Report of the Light-House Board.—This report, which is for the fiscal year ending June 30, 1887, contains a detailed account of work done in the sixteen light-house districts of the United States, with maps showing the locations of light-houses and light ships. The following are appendices; "Report upon the Electric Light Plant of the Statue of Liberty, New York Harbor", by Lieut. JOHN MILLIS, U. S. A.; "Report upon the Tests made of the Cements used at the Mosquito Inlet Light-House, Florida", by HERBERT BAMBER; "Report on the Working Platform used in the Construction of the Mosquito Inlet Light-House, Florida", by HERBERT BAMBER, Superintendent of Construction.

Thirteenth Annual Report of the Railroad Commissioners of the State of Missouri, for the year ending Dec. 31, 1887. JAS. HARDING, WM. G. DOWNING, J. B. BREATHITT, Commissioners, 6 x 9¼ ins.; 534 pp., cloth bound; with map. We are pleased to note that this commission is working in the direction of punctuality. The present report is dated June 1, while the report for the preceding year was dated July 20. Undoubtedly time enough should be taken by a State Commission to obtain accurate statistics before publishing them; but there seems little excuse for the great delay which attends the publication of the reports of some of the State Commissions. More extended comments on this volume will be made in a future issue.

Proceedings of the Michigan Engineering Society.. The Proceedings at the Ninth Annual Convention, held at Kalamazoo, Jan. 17 to 20, 1888. For sale by F. HODGMAN, Secretary, Climax, Mich. Price 50 cts.; 143 (pp.)

In addition to the Constitution, By Laws, List of Members, Reports, Addresses, Abstracts of Proceedings, etc., the volume contains the following papers: "Stray Thoughts of an Engineer in Cross Section and Profile", by WM. APPLETON, of Lansing; "Land Laws and Decisions", by F. HODGMAN, of Climax; "Highways & Highway Bridges", by W. B. SEARS, of East Saginaw; "Town Plats", by Mr. SHERMAN; "Map Drawing and Lettering", by C. S. DENISON, of Ann Arbor; "Highway Bridges, from the Point of View of the Public", by C. E. GREENE, of Ann Arbor; "Portage Lake & Lake Superior Ship Canal", by Mr. FORSTER; "Improvement of the Middle Neebish Rapids", by J. RIPLEY, of Detroit; "Invention of the Solar Compass", by JOHN H. MULLETT, of Williamston; "Surveying in Florida", by S. C. HODGMAN; "Heating by Hot Water", by R. C. CARPENTER, of the Agricultural College, Ingham Co.; "The Seneca River Bridge (New York Central R. R.), by O. C. GILLETTE, of Medina, N. Y.

Iowa Surveyors & Civil Engineers Association.—Proceedings of the Fourth Annual Meeting, December 1887. Secretary, FRANK PELTON, Des Moines.

In addition to the reports and the President's address there are brief papers on the following subjects: "Needed Legislation", by F. L. EASLEY, of Fort Dodge; "The Best Methods of Preserving Government Corners", by W. H. HOLSTEAD, of Toledo; "Random Notes", by J. BALL; "Iron Deposits in Iowa", by J. S. RATCLIFFE.

The Fifth Annual Report of the Association of Dominion Land Surveyors, Canada, may be obtained by enclosing an express company money order, or Postal money order, cashable in Canada, for 50 cts., to ARTHUR O. WHEELER, Secretary, Ottawa, Can. This report is well worth the price, to surveyors and civil engineers.

IMMIGRATION is slightly falling off, a fact which few will be disposed to regret; but as the falling off is but slight, and last year's immigration was quite large, the continued large current is rather a sign of continued good times, and as such will be welcome. Since 1874 the immigration has been as follows:

1874	1875	1876	1877	1878	1879	1880
261,232	181,635	130,103	105,092	108,832	133,070	347,747
1881	**1882**	**1883**	**1884**	**1885**	**1886**	**1887**
427,441	646,764	521,154	452,206	351,488	328,535	481,453

In 1882, 39,579 Chinese came to this country, and swelled the total by that amount, practically none having come since.

For this year and last the figures are:

	1878	1877
Month of August	35,812	37,308
2 mos. ending Aug. 31	76,729	76,388
8 mos, ending Aug. 31	362,937	362,839

Immigrants from Great Britain and Sweden and Norway have decreased, and from Russia and Germany increased.

THE PEARSALLS HYDRAULIC ENGINE is a new hydraulic machine acting on the principle of the hydraulic ram in so far as it obtains its power by the arrest of a column of water previously set in motion by gravity. But while the ram proper can not be made to deal with large quantities of water, on account of the violence of the action, the inventor of the above-named machine claims that he has overcome this difficulty, and has reduced the work to perfect smoothness in large powers. The advantages claimed further are—their economy over the turbine and pump, in substituting one machine for two; use with very dirty water, and very slight wear of parts The construction of this hydraulic engine, while mechanically simple, would yet require a number of illustrations to describe it intelligently. These illustrations and a very clear description can be obtained by anyone interested by applying to Mr. J. WALES MORGAN DRAPER, C. E., 145 Broadway, New York City. The inventor is Mr. H. D. PEARSALLS. Assoc. M. Inst. C. E., and M. Am. Inst. M. E.

SOCIETY PROCEEDINGS.

American Society of Civil Engineers.—At the meeting of the society on Wednesday, Oct. 3, a paper by JOHN A. BENSEL, Jun. Am. Soc. C. E., on "The New Transfer Bridge, Harsimus Cove, Jersey City, N, J., was read and discussed. We shall give details of the paper later. The general nature of the work has been already fully described in these columns.

CONSTRUCTION NEWS.

RAILROADS.

East of Chicago.

Existing Roads.

Franklin & Megantic.—It is reported that surveyors have been at work on an extension of this Maine line north to tap the Canadian Pacific. It is proposed in case the capital can be secured to build the extension, to widen the gauge of the Franklin & Megantic and the Sandy River railroads to standard. (They are at present only 2 ft. gauge), thus forming a short outlet to the coast.

*For the theory of Wind-strains, Tendency to Slide and Overturn, Material, Riveting, Pressures, Factors of Safety, Grades of Metals, Limiting Depths of and Thickness of Metals, etc., I refer to the incomparable work of J. T. FANNING'S "Hydraulic and Water Supply Engineering."

The Stand-Pipes of the U

Height of Dam.	Wichita, Kan.	Danville, Ill.	Louisville, Ky.	Cam'rid'e, Mass.	Henderson, Ky.	Milw'kee, Wis.	Catasqua, Pa.	Shelbyville, Ill.	Toledo, O.	Erie, Pa.	Belleville, N. J.	Bristol, Pa.
250												
248												
244												
240												
236												
232										33		
228												
224									225			
220												
216												
212												
208												
204												
200		200										
196		3-16										
192												
188												
184												
180												
176												
172												
168			170									
164			3-16									
160									¼			
156												
152												
148	15											
144	6-16											
140												140
136												5-16
132												
128											130	
124								125				
120								3-16	5-16			
116												
112												
108												
104												
100							100					
96							¼					
92												
88												
84												
80					80	80			⅜			
76					¼							
72												
68												
64						¾						
60												
56						⅝						
52												
48				¾		⅝						
44												
40						⅝			7-16			
36												
32						½						
28												
24		¾				½						
20		⅝										
16						⅜						
12		½										
8		⅜				⅜						
4	½	⅜	½	⅜	½	¾	⅜	¼	½		½	7 1
Diameter	2½	1⅛	4	5	5	5	5	5	5	5	6	6
Bottom		1 C	3 C	1½				½	4 C	2 C	½	
Material		I	I	I				S&I	I	I		
Date		'86	'60	'85				'86	'74	'68		
Brackets								B		O		
Guyed		Y	Y	O					O	Y		
Bolted		Y	O	Y				Y	O			
Cost to Clean			8	10				10				
Cost												
Pressure Day		35							60	90		
" Night									100			
Tower												

Gage 125, 8 col cables 18 ft. 140 ft., 195 ft.

16 ft. added since first built

the United States; their Heights, Diameters, Thickness, and other Details of Construct

[Rearranged and somewhat extended from the table accompanying paper by B. F. Stephens C. E., pu

Height of Dam.	Maquoketa, Pa.	Maquoketa, Ia.	Falls City, Neb.	Pipe Stone, Minn	Chillicothe, Mo.	Concord, Kan.	Menomonee, Wis.	Pierce City, Mo.	Freeport, Ill.	Baton Rouge, La.
250										
248										
244										
240										
236										
232										
228										
224										
220										
216										
212										
208										
204										
200										
196										
192										
188										
184										
180										
176										
172										
168										
164										
160										
156										
152										
148										
144										
140										
136										
132										
128										
124										
120										
116										
112										
108										
104										
100			100	100						100
96										
92										
88									88	
84								85		
80	80	80					80			
76		¾				75		¼		
72						3-16	134			
68										
64	¼									
60							.148			
56										
52										
48										
44										
40							3-16	5-16		
36								11-32		
32										
28								⅜		
24										
20							¼	13-32		
16								1-16		
12										
8							5-16			
4	7-19	½	....	....	....	½	⅜	½	⅝	
Diameter	12⅛	12⅛	12½	12½	12⅛	15	15	15	15	15
Bottom		½				½	⅝	....	....	....
Material		I				I	I	....	....	....
Date		'93					'85	....	....	....
Brackets			B	....	B	B		B	....	B
Guyed		O	O	....				O	....	O
Bolted			Y	....	Y			Y	....	Y
Cost to Clean										
Cost							10			
Pressure Day										
" Night										
Tower										

Erie, Pa.	Belleville, N. J.	Bristol, Pa.	St. Louis, Mo.	New York City, N. Y.	Allentown, Pa.	Joliet, Ill.	Burlington, Kan.	Mt. Pleasant, Iowa.	Lawrenceville, N. J.	Carlyle, Ill.	Landsale, Pa.	Arkansas City Kan	Garden City, Kan	Ottawa, Kan.	Marion, Kan.	Oswego, Kan.	St. Paul, Neb.	Gonzales, Tex.	Beaumont, Tex.	Columbus, Neb.	Dodge City, Kan.	Eastam, Md.	Paola, Kan.	Sandwich, Ill.	Asbury Park, N. J.	Orlando, Fla.	Lewisburg, Pa.	Caldwell & A. Kan.	El Dorado, Kan.	Hiawatha, Kan.	Great Bend, Kan.
233											10 ft. base, 6 ft. top.	Brackets 10x6																				
16 ft. added since first built	130	140 5-16	148	154 ¾		107 ¾	129	80 3-16	85 ⅛	115	120	125 ⅜	125 3-16	125 3-16	140 3-16	140 3-16	60 ⅜	80	100 3-16	100 ¼	100 3-16	100 5-16	100 3-16	125	125	130	140 3-16	140 3-16	140 3-16	150 3-16
	½	7 16		½	½	⅝	½	⅜	3-16		⅝	⅜	½	½	½	½	7-16	7-16	⅜	⅜	½	½	½	½	½	¼	½	½	½	½	½
	6	6	6	6	7	7	8	10	10	10	10	10	10	10	10	10	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
	½						½ S	½	½	½	3 C	½	½	½	½	½	½	⅜ S	½	½	½	¾	2⅛	⅝ I		½ c	⅝	2½ c	½	½	½
							I	I	I	I	I		I	I	I	I	I	I	I	I	I	I	I	S		I	I	I	I	I	I
							'86	'84	'84	'84	'84							'84	'88	'87			'86	'86		'86	'87	'84		'85		
							Y	Y	O	O	O	B	Y	Y	B	Y		Y	O	B	O	Y	O	O		Y		Y	Y	Y	B	B
											Y				Y				Y	Y	Y		Y	Y								
											10				6				3	5	5		3	5		10		5		10		
							7½				6			3¾					5	5	5		5	5½		6½	70	9		6		
90							66			30	50			60				40	53	45			45	70		60		55		85		
							77							110										85						120		

Portland & Rochester.—Surveys are in progress at Portland, Me., for a line from the Portland & Rochester depot to the Union Station.

Baltimore & Drum Point.—The Baltimore & Drum Point Railroad Co., it is said, propose to survey a line from their road at Millersville, Anne Arundel county, to the borders of the District of Columbia, near Washington City, 13 miles. Under their charter they can operate branch lines 20 miles long, connecting with their road. The Columbia Central Railroad is the name given to this proposed new enterprise. When the Baltimore & Drum Point road is built to Baltimore, so the project is stated, the Columbia Central would give a third line by that route from Baltimore to the District of Columbia, and after securing the necessary franchises in the District, there would be a third line between the two cities.—*Baltimore Sun.*

Ohio & Northwestern.—Receiver SAMUEL HUNT has been authorized by Judge SAGE, of the U. S. District Court, to issue receiver's certificates to the amount of $285,000 in payment for improvements and extensions of the road. The first thing to be undertaken is the completion of the Sciotoville extension. After this is finished, the old rails between Sardinia and Batavia Junction will be replaced with new heavy steel, which has already been ordered. The extension to Sciotoville is 5 miles in length, and was graded last season.

Baltimore & Ohio.—Considerable money is to be spent by the company on its Philadelphia terminals. Two piers are to be built on the Delaware river at Dickinson Street and at Snyder Avenue. The freight station at Race Street is to be altered and enlarged. The double tracking of the line is now finished all the way from Baltimore to Philadelphia, with the exception of 12 miles just north of the Susquehanna river. Here the grading for the second track has been completed and the rails will be laid next spring. Ex-Mayor HODGES of Baltimore, one of the State directors of the road, made the following statement to a Baltimore *Sun* reporter:

"With reference to the value of the business of the road I have this to say: President Spencer showed me a statement of the earnings derived from lines west of Baltimore from business to and from points east of Baltimore, including New York and Philadelphia and local points on the Philadelphia Branch, for the fiscal year ended 30th September, 1887, and a similar statement for the six months of the fiscal year, namely, from October to March, inclusive, which showed a relative increase of about 50 per cent., and he assured me that the second six months, ending with September, will show even a larger increase.

"I think I may say that the prospect of an early consummation of the arrangements with the Reading and New Jersey Central for through passenger trains to and from New York are extremely favorable. Soon after this shall have been accomplished the company will commence to build the approaches, in the line of completion, to the Arthur Kill bridge, which will bring into use the Staten Island terminals already owned by the company. The contract with the Reading and New Jersey Central provides fully for the traffic of the B. & O., to New York. This contract gives our company the right to deflect at some point near Elizabeth, N. J., and go to Staten Island

Ohio Southern.—Surveys are in progress at Springfield, O., for a belt railway, an enterprise in which this company and the Ohio, Indiana & Western are prime movers. The Ohio Southern company has appropriated $100,000 for the project and has made some progress in obtaining right of way.

Canada & St. Louis.—Middlebury township, Indiana, has voted $10,000 in aid of this road, now under construction through Elkhart county. Track has been laid from Goshen, Ind., several miles north.

Evansville & Richmond.—Oliver Ferguson & Co., of Bedford, Lawrence Co., Ind., who have a contract for 80 miles of this line, from Elnora, to Columbus, are letting sub-contracts. There is one tunnel and considerable heavy rock work on the line.

Pennsylvania.—The branch of the Pittsburgh, Youngstown & Ashtabula which is to be built to Canfield, Mahoning county, it is proposed to extend to a connection with the line which has been surveyed by the Pennsylvania company from Niles to Ravenna, O.

Toledo, Ann Arbor & North Michigan.—Work is to begin at once on the extension from Cadillac, Mich., to Frankfort, on Lake Michigan, 65 miles. It is supposed that steam propellors will be put on the lake to ply between Frankfort and Menominee.——The company is to assume control of the newly completed Toledo, Saginaw & Mackinaw railroad on Oct. 15.

South Pennsylvania.—A dispatch from Pittsburgh, Pa., Sept. 30 to the *New York Times* says:

The ultimate success or the absolute failure of the South Pennsylvania Railroad will be determined before the first of the year. The coming of Mr. Andrew Carnegie is awaited with great interest, for it is to him that the persons in this vicinity most deeply involved in the affairs of the road look for advice and assistance. The charter limit for the completion of the road is not far distant, and vigorous and concerted action is necessary to complete the great unfinished line. Dr. David Hostetter and Ralph Bagaley are the heaviest individual stockholders outside of the Vanderbilts. Their united holdings are about $3,000,000, of which 36 per cent. has been paid in. Mr. Andrew Carnegie, just previous to his departure for Europe, formulated a plan for reorganizing the road in which Dr. Hostetter and Mr. Bagaley at the time concurred. His coming is now awaited in the hope that the plans will be successfully completed.

It is noticeable that during all the months in which South Pennsylvania affairs have been at a standstill, the engineers' offices in the various towns along the route have been maintained by the payment of the regular rent, though closed for months at a time. This would indicate that ultimate measures for the completion of the road were contemplated.

New York, New Haven & Hartford.—The work of quadruple tracking the line between Mamaroneck and Port Chester, on the New York and New Haven division, is nearing completion. About ¾ of the track is laid, and the remainder of the work will be completed so that the four tracks can be used for moving trains by Dec. 1. Besides building the two additional tracks, much work has been done in lowering grades, and the large amount of rock work has made the improvement a very expensive one. Next season work will continue on the division from Bridgeport to South Norwalk, Ct., 14.38 miles; probably about 10 miles of this will be quadruple tracked during the season. The work is to continue each season until there are four tracks all the way from New York to New Haven. The improvements are paid for out of the company's surplus fund.

New York, Pennsylvania & Ohio.—Grading is nearly completed for the double track between Cleveland and Youngstown, O., but tracklaying and ballasting proceed slowly, owing to the heavy traffic over the line. It is expected to have double track ready for use for about half the distance by Nov. 1, and the completion of the remainder may be postponed till spring.——Rev. J. LOCKINGTON BATES, of England, is making his annual inspection of the property on behalf of the foreign holders of the company's securities.

New Projects and Surveys.

Highland Bridge Co.—It is stated that this company has two corps of engineers in the field locating a railroad from the site for the proposed bridge to the Erie road at Turners, N. Y., and on the east bank of the Hudson to a connection with the New York & New England R. R. The company proposes to build a single span suspension bridge 3,000 ft. in length across the Hudson river at Peekskill. The total cost of the bridge and approaches is estimated at $10,000,000. Gen. EDWARD W. SERRELL, 35 Wall St., New York City, is the President of the company.

Evansville, Ft. Wayne & Chicago.—A press dispatch from Wabash, Ind., states that this company, which proposes to build a railroad on the tow path of the old Wabash & Erie Canal from Lafayette to Fort Wayne, is to receive the aid of the Atchison, Topeka & Santa Fé in carrying through its enterprise; the presumption being that the Santa Fé is especially desirous of reaching out farther east.

SOUTHERN

Existing Roads.

Kentucky Union.—Grading is in progress on this road near Winchester, Ky.

Atlanta & Florida.—The corps of surveyors working on the extension of this road from Ft. Valley, Ga., south, are running a line to Madison, Fla., and after completing it, will make a survey to Brunswick, Ga. When the estimates of the cost of the two lines are made up, a decision will be reached as to which will be constructed.

Chesapeake & Ohio.—The receivership of this company was terminated on Sept. 29, and the property was turned over to President M. E. INGALLS, who has made the following appointments: C. E. WELLFORD, Assistant to the President. H. D. WHITCOMB, Consulting Engineer, in charge of new bridge construction. J. T. ODELL, General Manager.

Savannah, Florida & Western.—The last rail on the Thomasville, Tallahassee & Monticello Railroad was laid on Sept. 27. The line extends from Thomasville, Ga., south to Tallahassee, Fla., with a branch to Monticello, Fla., a total distance of 37 miles. The line was backed by the Savannah, Florida & Western company and will form a part of the Plant system.

Wilmington & Weldon.—President R. R. BRIDGERS will receive bids till Oct. 15 at Wilmington, N. C., for grading 22 miles of railroad, and building 1,500 ft. of trestle work.

Georgia, Carolina & Northern.—This road is now completed to within 10 miles of Chester, S. C., and 40 miles are in operation. The work of construction has been much delayed of late by the heavy rains.

Seaboard & Roanoke.—It is reported that this company proposes to begin work soon on an extension from Cheraw to Sumter, S. C. At Sumter connection will be made with the Eutawville Railroad, which will be completed to that point by Jan. 1, and over this line access can be had to Charleston, S. C., independent of the Atlantic Coast Line.

Louisville, St. Louis & Texas.—At the annual meeting of this company held at Louisville, Ky., W. V. MCCRACKEN, of New York City, was elected President; GEO. A. EVANS, Vice President; and JOHN H. SAMPLE, Chief Engineer.

Louisville & Nashville.—It is currently reported that this company has secured control of the Northwest & Florida Railroad, running from Montgomery, Ala., south 35 miles, and also that it is backing the Alabama Midland, which is to be built from Bainbridge, Ga., to connect with the Montgomery & Florida. The two lines when completed will furnish the Louisville & Nashville direct connection with the Plant system of Railway and Steamship lines, reaching the sea coast at Brunswick, Ga., and all principal points in Florida.

East Tennessee, Virginia & Georgia.—The directors of this company at their meeting in New York City, Oct. 2, voted to accept the offer made by the directors of the Richmond & West Point Terminal Co. for a 20-year lease of the company's property for a percentage of the earnings.

Norfolk & Western.—

ROANOKE, Va., Oct. 1, 1888.

EDITOR ENGINEERING NEWS:

I last week gave up my position as Engineer in Charge, West Virginia & Ironton Railroad, to accept the position of Engineer of Maintenance of Way, Norfolk & Western Railroad. During the summer I have completed surveys over a distance of 185 miles, from the forks of the Elkhorn at the end of the Elkhorn extension of the Norfolk & Western Railroad, in McDowell county W. Va., to a point a few miles beyond Ceredo, Wayne Co., in the State of Ohio. The route of the West Virginia & Ironton has been practically settled. I have made complete topographical maps of all surveys and have nearly completed the surveys and map of the locality about Ceredo, W. Va., where it is proposed to cross the Ohio river. The soundings of the river, current measurements, etc., have been taken according to the requirements of the U. S. Government in such cases of proposed railroad crossings of the Ohio River. Several miles of location have been projected on the maps, and the field location work will go on through the winter in the charge of C. C. WENTWORTH, Principal Assistant Engineer, Norfolk & Western Railroad. Actual construction is simply a question of time, as the proposed line traverses a very valuable mineral country throughout, though it is quite a wild and rugged one, requiring much bridge work and several tunnels. The maximum grades will be 1 per cent; maximum curvature, 12°.

Twenty miles of the Clinch Valley division of Norfolk & Western Railroad from Graham to Tazewell, Tazewell Co., Va., will be opened this morning for regular traffic.

CHAS. S. CHURCHILL, *Eng. M. of Way, N. & W. R. R.*

New Projects and Surveys.

Henderson State Line.—

HENDERSON, Ky., Sept. 27, 1888.

EDITOR ENGINEERING NEWS:

The Henderson State Line railroad is projected to run from Henderson to Bowling Green, Ky., about 100 miles. The company is organized and we expect to begin surveys the last of October, 1888. STARLING MARSHALL is Secretary of the company. No Chief Engineer has yet been appointed. S. K. SNEED, *President.*

Paintsville & Licking Valley.—

PAINTSVILLE, Ky., Sept. 26, 1888.

EDITOR ENGINEERING NEWS:

Nothing has been done toward the construction of the Paintsville & Licking Valley railroad, not even a survey. The enterprise has not, however, been abandoned. We have five years in which to begin work before forfeiture for non-use of charter.

J. F. STEWART, *Secretary.*

Cairo & Tennessee River.—The House of Representatives has passed a bill giving this company the right to bridge the Tennessee river at any point in Trigg, Monroe or Cumberland counties in Kentucky or in Clay county, Tennessee.

Bowling Green, Hartford & Ohio River.—

CALHOON, Ky., Sept. 27, 1888.

EDITOR ENGINEERING NEWS:

Information in regard to this company may be obtained of the Secretary, J. E. WILLIAMSON, 325 Third Street, Evansville, Ind. LABAN M. RICE of the same city, has been elected President of the company, and E. P. LEONARD, Peoria, Ill., Vice President. WM. B. NOE.

Richmond & Seven Pines.—Contracts for building this 8 mile dummy road at Richmond, Va., are reported let. A. L. JOHNSON is General Manager and A. G. BABCOCK is President.

THE NORTHWEST.

Existing Roads.

Duluth, Red Wing & Southern.—Grading is in progress all along the line between Zumbrota and Red Wing, Minn., about 15 miles.

Milwaukee, Lake Shore & Western.—About 200 hands are at work on the Ironwood extension of the Rhinelander branch. The road will enter Ironwood over the tracks which are now used as the spur to the Ashland Mine.

Chicago, Milwaukee & St. Paul.—The passing of the St. Paul dividend has led to the organization in London of the foreign holders of the company's stock, headed by J. S. Morgan & Co., who propose to keep a sharp lookout over the management of the company's affairs and make sure that the road is run in the interest of the stockholders.——The reports of the company's earnings for the third week in September were most gratifying to the company's friends. The earnings were $557,000, an increase of $30,000 over the earnings of the same week last year.

St. Paul, Minneapolis & Manitoba.—The annual meeting of the company was held at St. Paul, Minn., Sept. 26. The changes in the management were the election of ALLEN MANVEL of St. Paul, First Vice-President in place of JOHN S. KENNEDY of New York, and HENRY D. MINOT of St. Paul, a director in place of F. P. OLCOTT of New York City. The financial statement of the company for the year ending June 30, 1888, is as follows:

Gross earnings	$9,561,905.51
Operating expenses	5,156,065.55
Interest	2,793,751.23
Dividend	1,200,000.00
State tax	263,921.28
	$9,413,738.06
Balance	148,167.45

Winona & Southwestern.—The contractors have between four and five hundred men at work on the first division. The work is heavy here and includes a large number of bridges and one 1,800 ft. tunnel.

New Projects and Surveys.

Chicago & New Orleans.—

SPRINGFIELD, Ill., Sept. 26, 1888.

EDITOR ENGINEERING NEWS:

The Chicago & New Orleans Railroad is to run from Shumway, Ill., *via* Edgewood, Xenia, Wayne City, Harrisburg, Eddyville and Brooklyn to Paducah. The surveys are finished and the right of way is all obtained from Shumway to the Ohio river, 152 miles. The first 104 miles is through a country fairly easy for construction. The next 30 miles is through hills. The remainder is a rolling and swampy country. The maximum curve, 5°. It is proposed to bridge the Mississippi at the southern terminus. Complete profiles and maps with prospectus have been published. GEO. A. SANDERS of Springfield is President. CHAS. HANSEL, *Chief Engineer.*

Hornville & DuQuoin.—This company has filed its charter in Illinois and proposes to build a railway from Hornville east to a connection with the Illinois Central Railroad. FRANK HORN, FRANK KETTLER, M. LAXON and WM. JEREMIAH are interested.

Pawnee.—This company has been formed at Pawnee, Sangamon, Co., Ill., to build a railroad from Pawnee to Auburn, on the Chicago & Alton Railroad, about 12 miles. COLUMBUS WHITE, of Taylorville, JACOB M. STARK, CHAS. E. CLAYTON, and HENRY R. DAVIS, of Pawnee, are the incorporators. A preliminary survey of the line has just been completed.

Deadwood Central.—The Deadwood Central Railroad Co. has filed its charter in the United States land office, to secure right of way over government lands. Deadwood is the center of the system, and from there a branch will run to Hay creek, another to Briar Hill, one to Galena, one to Ruby Basin and one to Carbonate, in all amounting to 334 miles of narrow gauge track. The first line will be to Lead City, which will be open for traffic in December.—*Railway Review.*

THE SOUTHWEST.

Existing Roads.

St. Louis, Arkansas & Texas.—It is announced that this Southwestern system has passed into the control of JAY GOULD. President FORDYCE is said to have contradicted the report, but the following plausible particulars are given in a St. Louis dispatch to the New York *Times*:

The details of the deal by which the Missouri Pacific obtained control of the management of the St. Louis, Arkansas and Texas were as follows. It seems that it needed some $600,000 to pay its November interest, and that it was not at all clear that the money would be forthcoming. Cotton was a month late in coming to market, and although the company had all the business it could handle, yet owing to the lack of sufficient rolling stock and the poor condition of part of the line the company was not able to take full advantage of the situation. On the 150 miles of track south of Brinkley, Ark., to Camden the original light iron had not been replaced, and this part of the line was not in shape to take a heavy business. Then the Shreveport branch and most of the Texas branches were badly in need of ballast; in fact they had to have it as the rolling stock was being racked to pieces.

The road was originally built for $13,000 a mile, costing some $22,000,000 in all, and needed at least $2,000,000 or $3,000,000 to put it in good working order. Additional rolling stock had to be bought and quite an amount of back wages was due the employes, as the Cotton Belt was no more exempt from the effects of two years of depression than was the Missouri Pacific. The company found great difficulty in floating the seven-hundred-thousand dollar first mortgage bonds required to build from Malden to Delta, as Europe was full of American railroad securities and the New York market was dull. It was out of the question, therefore, to sell the bonds still in the treasury—second mortgages on the new branches. Yellow fever was delaying business also, and in view of the circumstances, when all other measures seemed exhausted, the officers of the road decided to sell these bonds, give stock with them in like amount for nothing, and give the purchaser control of the road for $3,000,000.

Thus Mr. Gould and his friends got a property that cost seven times as much, and that owing to its very low bonded debt and the splendid country through which it runs is capable of being developed into one of the finest pieces of railroad property in America. The $3,000,000 will be applied to the betterments mentioned as well as to paying the floating debts, including employes' wages and meeting the maturing interest promptly. About 150 miles of heavy steel rail will be laid, the new branches will be ballasted and some heavy engines and new freight cars and a few new passenger coaches bought. These improvements will put the road in shape to earn big money. The line from Malden to Delta will be completed Nov. 1 or Dec. 1 at the latest, and this will bring the Cotton Belt into St. Louis over the Iron Mountain. The vacancy in the Bondholders' Committee, caused by the death of Col. J. W. Paramore, was filled by the election of Louis Fitzgerald, President of the Mercantile Trust Company, purchasers of the second mortgage bonds, and who consequently advanced the money so urgently needed. Mr. Frank Pendleton resigns, and Mr. Russell Sage will be chosen, and Mr. Cappell will give way to make room for Mr. Gould, thus giving the Goulds three members out of five.

Atchison, Topeka & Santa Fé.—The most exciting financial incident of the week has been the action of the directors of this company on Oct. 2, in reducing the dividend for the quarter to ½ of 1 per cent. The announcement of the reduction brought down the price on the Boston Stock Exchange from 83⅜ to 75⅝ on the day the reduction was announced. One of the directors stated that the reduction was made, not on account of a shortage of business, but because close competition had reduced the traffic rates down to a very low point; and that the managers of the company's affairs deemed it the wisest and most conservative course to pay only such a dividend as the property had earned.

Southern Pacific.—Ricker, Lee & Co., of Galveston who have received the contract for grading the extension from Victoria, Tex., to Belleville, began work on Oct. 1.

Batesville & Brinkley.—The gauge of this Arkansas road was widened to standard on Sept. 27.

Chicago, Rock Island & Pacific.—The tracklayers on the Colorado Springs extension, expect to finish their work by the middle of October.——Referees have been appointed to assess the damages caused by the proposed extension through the Cherokee Nation in Indian Territory.

Texas & Pacific.—Greene & Brogan have been awarded the contract for the extension from Plaquemine, La., to a point on Plaquemine Bayou, about 9 miles.

Gulf, Colorado & Santa Fé.—Surveys are in progress for a proposed extension to run from Coleman, Tex., north *via* Pecan Springs to Colorado City, and thence north to a connection with the Santa Fé line through the Panhandle.

Kansas City & Pacific.—The contract for the extension from the present terminus at the east line of Anderson county to Paola, Kan., about 25 miles, has been let to Bethune & Craney Bros., who agree to complete the work Dec. 1.

Missouri Pacific.—Surveys are in progress for the extension of the Kansas & Arkansas Valley line, recently completed from Ft. Smith, Ark., to Wagoner, Ind. Ter., up the Arkansas Valley to Coffeyville, Kan.

Texarkana Northern.—This road, extending from Texarkana, Ark., to the Red River, about 8 miles, was built two years ago by citizens of Texarkana and was afterward leased for 5 years to W. L. WHITAKER of Texarkana to be used as a lumber road. Last Spring the stockholders made arrangements with J. F. HINCKLEY of Chicago and others to complete the road to Fort Smith, Ark., but little or nothing has been done, and Mr. WHITAKER has now brought suit against the company for $26,000, claiming to have spent that sum on the road.

New Projects and Surveys.

Greenwood & Eastern.—This company has been incorporated in Arkansas to build a railroad 20 miles in length to coal fields in Sebastian county. R. H. MCCONNELL, R. T. POWELL and others of Hackett City, Ark., are interested.

Kansas City, Ft. Smith & Southern.—This company has filed its charter in Arkansas, under which it proposes to build a railroad from the northern boundary of the State to the southern, running *via* Benton, Washington, Crawford, Sebastian, Scott, Polk, Howard, Sevier and Little River counties. The list of incorporators includes S. L. BUSH, THOS. BOLES and W. H. CRAVENS of Ft. Smith, SAM'L. H. REYNOLDS, Lancaster, Pa. and WM. J. LATTA, of Philadelphia. The city of Neosho, Mo., has raised $20,000 in aid of the enterprise and it is promised to complete the line from Jopin to Neosho by Jan. 1.

ROCKY MOUNTAIN & PACIFIC.

Existing Roads.

Mexican National.—The last spike on this road was driven at a point 508 Kilometers from the city of Mexico on Sept. 30. The distance from Laredo, Tex., to the city of Mexico by this line is 844 miles. The route between New Orleans, Kansas City, Chicago and all eastern points and the city of Mexico, according to General Passenger Agent WALTER MORCOM'S circular, will be 257 miles shorter than the Mexican International line *via* Eagle Pass and 654 miles shorter than the Mexican Central route *via* El Paso.

The first through train from the city of Mexico north arrived at Laredo, Oct. 3. On Oct. 15 the road will be opened for through freight traffic and on Nov. 1 for through passenger traffic.

Mexican Central.—An important contract has been closed between this company and the Mexican government whereby the company agrees to undertake extensive dredging operations in the harbor of Tampico.

Northern California.—On the extension from Knights Landing to Marysville, Cal., the portion of the line between Marysville and Yuba City, which was the most expensive section, is graded ready for the rails, which will be laid as soon as the bridge across the Feather river is completed. The grading on the 15 miles from Yuba City southwest will be ready for the rails in about a week. The road is expected to carry a heavy grain traffic when it is opened.

Union Pacific.—Reports come in from various sources of the progress of surveys under this company's direction in southern Oregon. The route which is under examination is from some point near Weiser City, Idaho, up the Malheur river, thence along the south side of Malheur and Harney lakes, leaving Warner lake to the south and Albert lake to the east, thence along the east side of Goose lake to the Fall River valley in California, and along this to the Sacramento river. The proposed line would run through a region now wholly without transportation facilities but according to the most reliable accounts of small value as an agricultural district. The principal object for the extension is supposed to lie in the fact that it would give the Union Pacific an independent line through to the Pacific coast.——According to the Denver *Republican*, there are seven surveying parties in the Union Pacific employ working in the vicinity of Red Cliff, Aspen and other points in the mining district of Colorado.

Seattle, Lake Shore & Eastern.—The first train over the eastern division of this road, made a short trip from Spokane Falls, W. T., on Sept. 26, with a party of invited guests. It is expected to complete 40 miles of this road during the present season, and to reach the Columbia river next May. Work has begun at Spokane Falls on a Union depot to be used by this line, the Oregon Ry. & Nav. Co. and probably the St. Paul, Minneapolis & Manitoba.

New Projects and Surveys.

Sierra Majada.—The officers of this company, noted in our issue of Sept. 22, are JOSE MARIA GARZA GALAN, President; SAMUEL LEDERER, Vice-President; ALEXANDER ELGUESABLE, Secretary; E. BAZ, Agent in City of Mexico. The line is to run from Jiminez, on the Mexican Central, to Lampasas, about 340 miles.

Astoria & South Coast.—The Portland *Oregonian* publishes an interview with A. C. KINNEY, of Astoria, Ore., one of the directors of this company, in which he expressed himself as follows in regard to the enterprise:

"The movement has taken the direction of a proposed line southward from Astoria along the ocean towards Tillamook and Yaquina bay. The amount raised so far is enough to complete a road as far as Seaside. It is possible that the Oregon Pacific will build northward along the ocean to a junction with the Astoria line. I am informed that this project has met with favor in Oregon Pacific circles. If an independent company, showing evidence of its ability to carry forward its part of the agreement, should propose to build a railroad from Astoria to a railroad connection to the eastward—Hunter's Point, or near Forest Grove, for instance—it could obtain a well-secured conditional subsidy of $150,000 in less than two weeks' time. There is enough business now in sight for such a road to make it a better paying line than any equal extent of railway line in Oregon."

Mexico.—The Matamoras *Revista* says that a Chicago syndicate are to apply to the Government for a charter for a railroad from Bagdad to Matamoras and thence down the coast to the City of Mexico, connecting with that point by the railway to Pachuca.——The survey for the new railway from Jalapa to Vera Cruz was started on September 26.

Proposals Open.

Harbor Improvement.—The date for receiving proposals for improving the Harbor of Rio Grande, Do Sul has been extended by the Imperial Government of Brazil until February 6, 1889. J. AUG. DA COSTA, Brazilian Chargé d' Affaires, Washington, D. C.

Rubble-Stone.—150,000 tons of rubble-stone, required for the Harbor of Refuge, Sandy Bay, Cape Ann, Mass. Also for 10,000 tons of rubble-stone in Newburyport Harbor, Mass.. G. L. GILLESPIE, Lieut. Col. of Engineers, U. S. A., Boston, Mass. October 31.

Water-Works.—Complete system at Richmond, Ky. F. A. ADAIR, Secretary, Richmond Water-Works Co. October 13.

Bridge.—Iron bridge, with two 50 ft. spans and one 200 ft. span. J. W. HOPKINS, City Engineer, Paducah, Ky. October 15.

Macadamizing.—2,445 lin. ft. of macadam. C. W. FOSTER, Chief Quartermaster, U. S. A., Fort Leavenworth, Kan. October 12.

Iron Bridge.—In Harrison Township, O., FRED RAINE, County Auditor, Cincinnati, O. October 20.

Water-Works.—At Pinconning, Bay Co., Mich., complete system. Plans on file in Village Clerk's office. D. O. MCDONNELL, Village Clerk. October 22.

Breakwater Extension—At Port Arthur, Ont., WM. MURDOCH, Resident Engineer, Port Arthur, Ont.

Grading.—Grading grounds about Texas State Capitol at Austin, and constructing drives and walks. W. A. RHEA, RHOADS FISHER, W. C. HOLLAND, Austin, Tex. October 22.

Street Improvements.—Grading, draining, curbin gravelling and improving St. Clair Street, in the village of Glenville, O. CHAS. B. COOK, Village Clerk. October 31.

Water-Works Supplies.—At Boston Navy Yard, 207 tons of cast-iron water pipe with hydrants, cocks, meters, gates, etc., necessary for complete water-works system. ——At Norfolk Navy Yard, 125 tons cast-iron pipe and all fittings necessary for complete water-works system.——At New York Navy Yard, 1,000,000 brick and all supplies required for building new boiler shop. JAS. FULTON, Paymaster General, U. S. Navy, Washington, D. C.

Vitrified Pipe.—Furnishing and laying 18-inch and 12-inch at Albany, N. Y., THOS. J. LANAHAN, Clerk.

Water-Works.—Complete system at Gladwin, Mich., 2 steel boilers, 32 in. × 12 ft. Duplex pump, 250,000 galls. capacity, 9 hydrants, three 6-in gates, 4,382 ft. 6 in. cast-iron pipe, 108 ft. 4 in pipe, 1 ton specials, brick engine and boiler house. EUGENE FOSTER, Clerk.

Contracting.

Pumping Engines.—City Works Commissioner ADAMS, Brooklyn, N. Y., has awarded the contract for building new engines and engine house at Ridgewood to Henry R. Worthington & Co. of New York City for $190,471.

Pumping Engines.—The authorities of Chicago, Ill., have awarded a contract to E. P. Allis & Co., of Milwaukee, for five triple-expansion condensing pumping engines of the same design as the West Side plant, recently built by that firm for Milwaukee. The capacity of the Chicago engines will be 15,000,000 galls. of water per twenty-four hours each, making a total of 75,000,000 galls. per day. One of the engines will be located at the Harrison street station, and the other four at a new pumping station on Indiana avenue and Fourteenth street. The cost of the engines will be about $500,000.

Dredging.—The following bids have been received by Lieut Col. J. G. CHANDLER, Dept. Quarter Master General, U. S. A., New York City, for dredging at Willett's Point, David's Island, and Ft. Schuyler, N. Y. Harbor: P. Sanford Ross, $4,900, if pumping ground is not located more than 12 miles from Ft. Schuyler, and $8,500, if material must be towed to sea. Morris & Cunningham's Dredging Co.: $4,500, if dumping ground is not more than 10 miles from Ft. Schuyler, and $9,000, if material has to be taken beyond Sandy Hook. Above figures do not include rock. Award will not be made until dumping ground is located.

Baltimore, Md.—The following proposals for dredging the ship channel leading to the Port of Baltimore, Md., have been received by Wm. P. Craighill, Col. of Engineers, U. S. A. at Baltimore; American Dredge Co. Philadelphia, Pa., 11 cts. per cu. yd.; Geo. C. Forbes & Co. Baltimore, 11⅞ cts. per cu. yd.; National Dredging Co., Wilmington, Del., 1⅞ cts. per cu. yd.; Baltimore Dredging Co., 12 cts. per cu. yd.; P. Sanford Ross, Baltimore, 13 cts. per cu. yd. and The Atlas Dredging Co., Wilmington, Del., 12⅝ cts. per cu. yd. Contract has not been awarded as yet.

Albany N. Y.—Contract for dredging 7,000 yds. at Nine-Mile Tree has been awarded to P. W. Myers, Albany, N. Y., at 16 cts. per cu. yd., and for dredging 23,000 yds. at the Oversinaugh, to E. M. Payn, Albany, N. Y., at 17⅝ cts. per cu. yd., by Jas. Shanahan, Superintendent of Public Works, Albany, N. Y.

River Improvements.—***Richmond, Va.***—The following proposals for work in James river have been received by Wm. P. Craighill, Corps of Engineers, U. S. A.: Dredging 500,000 cu. yds. of sand and gravel: (bids per cu. yd.) Geo. E. Ward, Richmond, Va.; 16⅝ cts., American Dredge Co., Philadelphia, Pa.; 16 cts. Excavating 3,000 cu. yds. disintegrated rock (per cu. yd.) O. J. Jennings, $2; Amer. Dredge Co., 60 cts.; C. D. Langhorne, Richmond, Va.; $1.45; Alabama Dredging & Jetty Co., Mobile, Ala., $1.50. Excavating 3,000 cu. yds. solid rock (per cu. yd.); O. J. Jennings, $9. Amer. Dredge Co., $9 C. D. Langhorne, $7.45; Ala. D. & J. Co. $6.33⅓. Constructing 2,900 lin. ft. Mattress Dyke from Jetty 84 to 96; Amer. Dredge Co. $4.50; C. D. Langhorne, $3.25; Ala. D. & J. Co., $3.38; J. Allard, Jr., Richmond, Va. $3.16; J. F. Bradley, Manchester, Va. $3.09; L. A. Guy, Richmond, Va. $3.05; J. F. Gaynor, Fayetteville, N. Y., $2.47; I. B. Dorset, Manchester, Va. $3.20; Cline & Isaac, Richmond, Va. $3.04. Constructing 6,200 lin. ft. mattress dyke from Jetty B to 29 (per lin. ft.) Amer. Dredge Co. $4; C. D. Langhorne, $2.65; Ala. D. & J. Co. $3.38; J. Allard, Jr. $3.16; J. F. Bradley, $2.74; L. A. Guy, $1.66; J. F. Gaynor, $1.75; T. B. Dorset, $2.34; Cline & Isaac, $2.32 if awarded separately, $3.04 if awarded contract for all the work. Constructing 600 lin. ft. jetty, (per lin. ft.); Amer. Dredge Co. $4; C. D. Langhorne, $3.25; Ala. D. & J. Co. $3.38; J. Allard, Jr. $3.16; J. F. Bradley, $3.09; L. A. Guy, $3.05; J. F. Gaynor, $2.47; T. B. Dorset, $3.20; Cline & Isaac, $3.04. Extending 400 lin. ft. Jetty; (per lin. ft.) Amer. Dredge Co. $4; C. D. Langhorne, $3.25; Ala. D. & J. Co. $3.38; J. Allard, Jr. $3.16; J. F. Bradley, $3.09; L. A. Guy, $3.05; J. F. Gaynor, $2.47; T. B. Dorset, $3.20; Cline & Isaac, $3.04.

The contracts were awarded as follows: excavating disintegrated and solid rock, to the Alabama Dredging & Jetty Co.; dredging sand and gravel, American Dredging Co.; constructing mattress dykes from 84 to 96 and from B to 36, also for all jetty work, to John F. Gaynor, Fayetteville, N. Y.

Sewer.—***Yonkers, N. Y.***—The following proposals have been received: W. E. Dean, New York City, $17,500; Everson & Liddle, $21,000; D. Murphy, $23,975; J. & G. Stewart, $27,500, and J. G. Ryan, $27,750, all of Yonkers, N. Y.

Helena, Mont.—The contract for the construction of sewers has been awarded to Green & DeWitt, of Helena, for $105,000. For furnishing sewer pipe to the Helena Steam Heating & Supply Co. for $43,834.43.

Bridge.—The following proposals for the superstructure for Wabasha Street bridge, St. Paul, Minn., have been received by the Street Committee and City Engineer for alternatives Nos. 1 and 2: South Park Bolt & Bridge Works, $83,814.75, $89,254; Keystone Bridge Co., $94,080; $96,880; Edge Moor Iron Co., $95,004, $96,904; W. H. Keepers, $94,146; $97,902; H. E. Horton, $96,399, $98,599.99; G. E. King, $96,155, $101,155; New Jersey Steel & Iron Co., $97,401, $101,591; Lassig Bridge & Iron Works, $98,770: $101,420; J. W. Walker, $105,395, and $166,845. The contract has not been awarded.

Water Bonds.—***Sing Sing, N. Y.***—The contracts for the water bonds have been awarded as follows: 1st series, $20,000, awarded to the Westchester Co. Savings Bank, at $105.75; 2nd series, $30,000, awarded to G. A. Benwell, New York City, at $109.27; 3rd series, $100,000; awarded to the Troy City Savings Bank at $108.15.

Water-Works.—***Lebanon, Ky.*** Abstract of bids received September 17, by J. D. Cook, C. E., of Toledo, O., engineer of the Lebanon Water-Works.

PIPES AND SPECIAL CASTINGS.

Dennis Long & Co., Louisville, Ky.,	$27.25 per ton, for all sizes; 3 cts. per lb. for special castings.
Addyston Pipe & Steel Co., Cincinnati, O.,	28.50 " " " 3 " " " "
Joseph Coyne, Louisville, Ky.,	27.50 " " " 3 " " " "
John Broderick, Nashville, Tenn.,	272.50 for all pipe, $600 for all the specials.

PIPE LAYING.

Name and Address of Bidders.	4 in.	6 in.	8 in.	10 in.	12 in.	Conduit.	Aggregate.	Remarks.
	cts.	cts.	cts.	cts.	cts.			
H. Merigold, Lima, O	17⅛	19¾	28	28	.....	$1.35	$10,386.65	Straight bid.
Samuel Green, Nashville, Tenn	24	29⅜	39¾	49	59	.....	15,986.34	" "
A. B. Cleveland, Unionville, O	20	24	28	32	36	.....	11,705.92	Rock work at actual cost.
R. B. Carothers, Newport, Ky.	15	17	22	25	....	....	8,763.08	Straight bid.
J. Coyne, Louisville, Ky.	23	23	31	33	.....	.....	12,013.64	" "
John Broderick, Nashville, Tenn	35	35	35	35	.....	.....	14,762.40	" "
Approximate of quantities, lineal ft.,	5520	11790	11924	13230		350		

RESERVOIR.

Name and Address of Bidders.	Stripping p. cu. yd.	Excavation per cu. yd.	Concrete per cu. yd.	Broken stone p. cu. yd.	Stone lining per cu. yd.	Brick p. M. in wells.	Stone p. cu. yd. in wells.	Spri'k-ling & rolling p.c. yd.	Aggregate.
Joseph Elder, Lebanon, Ky	.25	.30	$3.00	$2.00	$1.75	$5.00	.....	.40	$4,289.05
Monroe & Richardson, Portsmouth, O	.25	.29	6.00	1.40	3.47	.....	$7.00	.....	6,875.00
W. B. Monser, Lebanon, Ky	.30	.35	4.00	3.00	2.00	14.00	8.00	.....	5,093.34
F. Monser " "	.30	.40	6.00	3.50	2.00	14.00	8.00	.....	5,373.34
Daisey & England, Lebanon, Ky.	.30	.40	4.00	2.60	3.75	118.00	115.00	.....	7,810.00
Joseph Coyne, Louisville, Ky	.40	.40	3.40	1.40	1.46	18.00	5.50	.30	4,419.58
John Broderick, Nashville, Tenn	.35	.60	4.50	1.50	2.00	11.00	.....	.....	6,258.41
Quantities, cu. yds	700	4000	15	100	1500	781 M.	15		

SUPPLY WELL AND CONDUIT.

	Well		Conduit			
	Brick	Stone	Iron	Stone	Wood	Total Iron
W. B. Monser, Lebanon, Ky	$1400.	$1375.	$1.40	$1.10	75 cts.	$400.00
F. Monser, " "	1400.	1375.	.....	.....	.....	.....
Joseph Coyne, Louisville, Ky	778.	662.	$1.95	$2.29	.....	$682.50
John Broderick, Nashville, Tenn	2430.	.....	.....	.....	.....	.....

BUILDING AND CHIMNEY.

Joseph Coyne, Louisville, Ky., $1,512.35, Wood Building, Brick and Iron Chimney; John Broderick, Nashville, Tenn., 700 Wood Building only. Daisy & England, Lebanon, Ky., $7 per cu.vd. stonework in foundations.

VALVES AND HYDRANTS.

Name and Address of Bidders.	Valves and Valve Boxes. 12-in.	10-in.	8-in.	6-in.	4-in.	Hydrants. With frost-cases.	Without frost-cases.	8-in. Check Valve.	Valve Boxes.
J. Coyne, Louisville, Ky	$83.00	$63.	$55.	$31.	$19.	.....	.....	$40.	
Bingham & Taylor, Buffalo, N. Y., Boxes only	3.65	3.65	3.30	3.30	3.				
Whittier Machine Co. Boston, Mass.	40.25	31.50	21.75	13.75	8.50	$26.60	$24.10	31.	$4.60
A. W. Morgan, Buffalo, N. Y. (Boxes only)	3.05	3.05	3.05	3.05	2.75				
Frontier Iron & Brass Works, Detroit, Mich	32.	24.	16.80	12.	7.60				
A. W. & S. Carr, Patterson, N. J.	30.	22.	17.	10.	6.75	.....	28.	32.	4.
Chapman Valve Mfg. Co., Indian Orchard, Mass	44.14	32.52	21.36	14.39	9.33	.....	23.59	34.71	
Chapman Valve Mfg. Co. (Chicago Office)	43.66	31.17	21.13	14.23	9.23	24.92	22.38		
Jas. Flower & Bros., Detroit, Mich	37.	26.50	18.70	12.40	7.95	.....	23.50	18.70	
Eddy Valve Co., Waterford, N. Y.	40.	30.	22.	13.20	8.		25.	20.	3.
Bourbon Copper & Brass Works, Cincinnati, O	36.	28.	18.50	13.20	8.	25.50 27. 28.50	22.25		
Galvin Brass Works, Detroit, Mich	36.	27.	19.50	12.35	8.40	24.50 27.40	.....	21.	2.65
R. D. Wood & Co., Philadelphia, Pa.	39.50	31.	21.50	14.25	9.	28.50	.....	50.	3.50
Holly Mfg. Co., Lockport, N. Y.	51.	37.20	27.60	18.	11.40	27.50			
Approximate number of each size,	1	3	4	22	13	40	40	1	43

Jetty.—The following proposals for building a jetty at the entrance to Galveston Harbor, Texas, were opened September, 20, 1888, by Major O. H. Ernst, Corps of Engineers, U. S. Army, at Galveston, Texas.

No. of proposal.	Name and address of bidder.	Riprap 105,000 cu. yds. per cu. yd.	Blocks of st'ne ¾ ton to 2 t'ns each 8,000 cu yds. per cu. yd.	Blocks of stone 2 to 5 tons e'ch 23,000 cu. yds. per cu. yds.	Railway 13,500 linear feet. per lin. foot.	Rails 6,900 linear feet. per ft. of j'tty	Total Amount.
1	A. M. Shannon & Co., Galveston, Tex	$2.08	$4.30	$4.30	$3.25	$1.00	$402,475
2	Geo. W. Burkitt, Palestine, and T. C. Stribling, Brenham, Tex.	2.00	4.40	4.50	3.80	.80	468,520
3	Louisiana Jetty and Lightering Co., New Orleans, La	2.55	4.33	4.33	3.10	.70	448,660
4	Ricker, Lee & Co., Galveston, Tex	2.06	3.43	4.12	*30.97	*7.31	807,034
5	Samuel W. Swift, Austin, Tex	2.21	3.85	4.25	3.50	1.00	414,750

† No. 1, lowest; acceptance recommended.

* After bids were opened Ricker, Lee & Co. stated that their figures for railway and rails were clerical errors, and should have read $3.09 per foot for railway and 73 cents for rails.

Cove Basin Walls.—Providence, R. I. The following proposals have been received by W. P. VAUGHAN, Chairman Joint Committee, for building the Cove Basin Walls.

Kind.	Quantities.	Engineer's Estimate.		Jas. J. Newman, Providence, R. I.		R. J. Malone and Jno. T. Moore, N. Y. City & Newburgh, N. Y.		Boynton Bro's, Prov. & Boston		Atlantic Dredging Co. N. Y. City.		Sam'l R. Bullock N. Y. City.		Fr'nklin A. Snow Prov., R. I.		Chas. F. Mairs, N. Y. City.		Shaw & Whittlesey Prov., R. I.		Jos. Ross, Ipswich, Mass. Thos. A. Rowe, Newton " F. H. Blaisdell, Lynn, "		Edw. L. Suffern, Plainfield, N. J.	
		Rate.	Amount.	Rate.	Amount.	Rate.	Amount.	Rate.	Amount.	Rate.	Amount.	Rate.	Amount.	Rate.	Amount.	Rate.	Amount.	Rate.	Amount.	Rate.	Amount.	Rate.	Amount.
A. Excavation	124,960 cu. yds.	$ .40	$49,960.00	$ .30	$37,470.00	$ .40	$49,960.00	$ .60	$74,940.00	$ .30	$48,711.00	$ .38	$47,482.00	$ .44	$54,956.00	$ .42	$52,458.00	$ .4634	$57,766.25	$ .75	$93,675.00
B. Sand or gravel filling	83,690	.50	41,975.00	.60	50,570.00	.60	50,570.00	.60	50,570.00	.60	50,570.00	.58	48,536.00	.60	50,910.00	1.65	2,521.20	3.00	4,584.00	4.00	6,112.00
C. Rip Rap	1,528	2.50	3,820.00	3.00	4,584.00	2.40	3,667.20	2.00	3,056.00	6.50	1,265.00	7.00	1,290.00	5.50	1,470.00	5.50	1,155.00	10.00	2,100.00	6.00	1,260.00
D. Concrete	210	10.00	2,100.00	7.00	1,470.00	6.00	1,260.00	5.00	1,050.00	4.50	3,600.00	5.00	4,000.00	7.00	5,600.00	9.80	7,920.00	3.75	3,000.00	10.00	8,000.00
E. Piles	800	6.00	4,800.00	7.00	5,600.00	5.70	4,560.00	5.00	4,000.00	3.70	2,960.00	3.75	3,000.00	7.00	5,600.00	9.80	7,920.00	3.75	3,000.00	6.00	4,800.00
F. Spruce capping	18,250 ft. B. M.	35.00	638.75	35.00	638.75	25.00	456.25	40.00	730.00	30.00	547.50	40.00	730.00	30.00	547.50	30.00	547.50	40.00	730.00	60.00	1,095.00	35.00	638.75
G. Rub'r masy'ry in cement	8,485 cu. yds.		59,395.00	7.00	59,395.00	6.40	54,144.00	6.00	50,790.00	7.25	61,335.00	8.50	71,910.00	5.50	46,530.00	5.75	48,645.00	7.50	63,450.00	7.00	59,220.00	8.50	71,910.00
H. " dry	3,485 cu. yds.	10.00	112,850.00	12.00	83,900.00	11.00	31,075.00	8.00	22,600.00	12.00	33,960.00	12.00	33,960.00	16.50	46,612.50	14.00	39,550.00	13.00	36,725.00	11.00	31,075.00	15.00	42,375.00
I. Old coping set	3,383 lin. ft.			.35	1,166.55	.60	1,999.80	.70	2,333.10	.50	1,666.50	.40	1,333.20	1.25	4,166.25	.60	1,999.80	.60	1,999.80	1.80	5,999.40
J. " railing	2,603 "	.50	1,666.50	.50	1,301.50	.75	1,952.25	.50	1,301.50	1.00	2,603.00	1.05	2,733.15	1.75	4,555.25	.80	2,082.40	.80	2,082.40	1.50	3,904.50
Total		+10%	21,781.03																				
			$289,591.28		$193,920.80		$198,045.00		$269,960.60		$211,738.00		$215,075.35		$216,717.50		$252,921.35		$229,597.45		$252,370.30		$311,108.65

Contract has been awarded to James J. Newman, of Providence, R. I.

Sewers.—San Jose, Cal. Contract for subsiding sewer has been awarded to THOS. DOYLE, San Jose, Cal., for $723. Other bidders were San Jose Improvement Co., $847; CHAS. WEHNER, $744; W. J. SCHMIDT, $853.90. Bids for concrete floors were rejected as being too high.

Railway Contracts.—*Georgia Pacific.*—The contracts for grading 17 miles of the extension between West Point, Miss., at Winona, and for also filling in all the trestles between Atlanta, Ga., and Birmingham, Ala., have been awarded to McLaughlin Bros., of Columbus, Miss.

Oregon Pacific.—The contract for the completion of 15 miles of the line between Albany, Ore., and Boise City, Idaho, has been awarded to Searle & Deane.

River Improvements.—The Mississippi River Commission held its meeting in New York on Sept. 24, Gen. C. D. Comstock, President of the Commission, presided, and Major O. H. Ernst of the Corps of Engineers U. S. Army, recently appointed on the Commission who arrived from Galveston recently, joined the commission and participated in its proceedings.

Appropriations aggregating $835,000 were passed upon as follows: Columbus, Ky., $25,000; Hickman, Ky., $70,000; Helena, Ark., $75,000; Greenville, Miss., $75,000, Vicksburg, Miss., $150,000; New Orleans, $200,000; at the head of Atchafalaya river and the mouth of Red river $200,000.

The Commission expects to conclude its labors at once, the remainder of the appropriation to be disposed of being $1,165,000.

Sewers.—*Mount Vernon, N. Y.*—The contracts for building district trunk sewers have been awarded as follows: 1st section: to Everson & Liddle, for $18,370.75; 2nd and 3rd sections, to Byron & Clark, for $20,105.25. 4th section, to Adams & Co., for $2,703.00.

WATER.

York Beach, Me.—A system of sewerage is projected for this town, which has a large summer population. The plans will be prepared by Mr. JORDAN, C. E., of Portland, Me., who has just made surveys and taken the levels for the work. The plans for the proposed system will be submitted at a town meeting. The new waterworks, which were completed in July, have been shut down for the winter season, and the pump taken away. There is some dissatisfaction at this, as it was expected the supply would have been maintained till November at any rate. The distribution pipes are mostly laid along the surface of the ground. The water is pumped from a well to a wooden tank elevated on a high tower, of wooden trestle work. The water is said to be of very good quality. Most of the large hotels have their own wells for water supply, and at the Marshall House, York Harbor, a new well has been put down 270 ft. There is complaint over the charges of the water company, which appear to be very high considering the short time that a supply has been furnished. Next season, however, the water question will be more efficiently managed. It is pleasant to note that watering places are now giving practical attention to the once neglected matters of water supply and sewerage; matters which are of greater importance really than the advertised scenery and beaches. There is quite a large field open for engineering services in these directions.

Water-Works.—*Maine.*—Brewer. Rock work has retarded the progress of the water-works somewhat, but it is stated they will be completed in a few weeks. ——Norridgewock. Contract to construct water-works has been let.— Eastport. The contractors have resumed work on the water-works and it is expected they will be completed before December 15.

Massachusetts.—Springfield. The 12-in. cement-lined water main which burst last week, necessitated the laying of 1,000 ft. of 8-in. cast-iron pipe. The main is an important one as it supplies the gas company and is under a pressure of 120 lbs. to the square inch.——Greenfield. The Water Commissioners have laid larger mains in the southern part of the town during the past season.—— Northampton. Trouble is being experienced with the water from Beldings last well, from which 40,000 galls. are being pumped daily, and it is reported to be unfit for use.——Malden. A ¾-in. wrought-iron reservoir of 1,158,000 galls. capacity, 75 ft. in diameter and 35 ft. high, which is to stand a strain of 5,000 lbs. per sq. in., is to be furnished to the City Water-works, by the Cunningham Iron Works, of Pittsburgh, Pa.

Rhode Island.—Conanicut Island. A water-works system will be established next season.——Pawtucket. The 6,000,000 galls. Corliss pumping engine has been put in operation, and the filtering basin is now in course of construction.

Connecticut.—Canaan. The Water Company is laying a larger main through Granite Avenue below the frost limit. Rock has been encountered which will greatly retard the work.

Dist. of Columbia.—Washington. The Water Commissioners have decreased the water rate, by meter, from 5 to 3 cts. per 1,000 galls.

New York.—Saratoga. Water mains are now being laid on Ballston Avenue.——Yorkshire Center. The question of putting in a system of water-works is now being agitated.——Scottsville. A new reservoir for fire protection has been constructed.——Rochester. Extensions of mains and improvements are to be made. Bids for laying mains in a number of streets have been received.——Glens Falls. The composition water mains have caused a good deal of trouble by bursting recently and may have to be replaced by new cast-iron pipe.

Pennsylvania.—Washington The water-works have been put in operation.——Newtown. It is reported that water-works will be completed within 30 days.——Reading. The bill to make a loan of $300,000 for the purpose of introducing the water of the Maiden creek as an additional water supply, failed to pass in Common Council recently, and has been abandoned in its present shape. A bill will now be presented urging the introduction of Schuylkill water, though many large manufacturers protest against it on account of its destructive effect upon boilers.——Homestead. The Homestead Water Co. has been incorporated by LOUIS ROOT and others. Capital $100,000.

Delaware.—Newark. A water supply system, which will include a well fed by springs and a stand-pipe 50 ft. in height by 25 ft. in diameter, with a capacity of 184,000 galls., is now nearing completion.

Michigan.—Pontiac. The water works will be completed sometime next month.

Indiana.—Indianapolis. The Council will soon be called upon to take action with reference to the city Health Board's investigation of the Water Company. The majority of councilmen seem to be in favor of sealing the valve connecting the canal flume with the well at the pump-house, and then give the Health Board authority to see that the company does not violate its contract again.

Illinois.—Chicago. The new crib for the water-works is anchored in the lake at the foot of Peck court. Mr. Hall, the superintendent, still feels confident of moving the structure, and says he will attempt the work again next week. The whole difficulty, he thinks, was with the barges, and they will be repaired. "It shows plainly that when we get it anchored in the lake there will be no danger of the wind and water moving it," said Mr. Hall. He has no idea of letting it remain where it is or of taking it apart, but expects to have it launched within two weeks.

Missouri.—Washington. Mr. Beinker, of St. Louis, has commenced the erection of the superstructure of the pumping house of the water-works, and JOHN MAXWELL contractor for laying the water mains, has completed his work in the business part of the city. There is still about a mile of mains to be laid on Front Street, from the pumping house to the Fair Grounds.

Iowa.—Mt. Pleasant. The capacity of the water-works is being increased and the system is being improved.

Minnesota.—St. Paul. A 12-in. water main has been laid through Third Street, from Broadway to Jackson. Heretofore 6-in. mains have been used, but these were considered inadequate. Mains have been laid through the wholesale district, and a gang of 135 men are busy continuing the work to Jackson Street. The relaying of the new pipes from the main artery on Broadway to Wacouta Street has been completed. In two and three-quarter hours 360 ft. were relaid, and during one hour of that time the pipes were relaid at a rate of 1,300 ft. a day. The work is being done under the supervision of Supt. Overton.——Winona. There has been considerable trouble in securing a sufficient hydrant pressure for fire purposes, and a sand pump has been put in operation.

Oregon.—Salem. Harry Stuttsman, engineer of the East Portland Water Company, has returned from Salem, where he made an examination of the pumps in use by the water company, and will recommend that they purchase a Dow pump, with a capacity of 1,250,000 galls. per day.

California.—Redland. Complaint is being made of the quality of the water furnished by the water company, and because the water is not always available in the service pipes.

Arizona.—Phœnix. It is expected the water-works will be completed before Jan. 1, 1889.

Nebraska.—Lincoln. Six new wells at the N street crossing have been connected with the O street mains. These wells will yield about 12,000 galls. of pure water daily. A larger well is being sunk at the East Lincoln pumping station and other improvements and extensions are being made.

Colorado.—Greeley. Water-works are to be constructed. The Greeley Reservoir & Irrigation Co., has been incorporated by H. M. DEVOBE and others. Capital $100,000.

Kansas.—Osborne. The sum of $35,000 has been voted for the purpose of establishing a system of water-works.——Fairmount. The water-works company has completed the construction of the water-works and started the pumps, everything coming up to their expectations.——Wichita. The Wichita Water Co. (a branch of the American Water-works & Guarantee Co.) are about to make some extensions. From present terminus on Chicago Ave. to the Garfield University (1 mile), from Washington Ave. to College Hill (2 miles), and some few small extensions. They also propose duplicating their main from the plant to main central supply

this latter necessitating crossing the Little Arkansas at or under its bottom.

Texas.—Greenville. The Greenville Water & Electric Light Co., has been incorporated by J. M. Cook and others to build water-works. Capital $100,000. Work will be commenced on October 5, and be completed in 8 months.——Tascosa. The water company will extend its water supply system.——Galveston. Work on the artesian well contract is progressing favorably, and work has been commenced on well No. 5. The rotary process will be used. Well No. 3 is to be sunk to a greater depth as the flow of water is not sufficient to make it a success.

Arkansas.—Pine Bluff. The water-works are completed. About nine miles of iron pipe have been laid. E. G. Trueheart is City Engineer.

Tennessee.—Dyersburgh. Water-works are being constructed.

Georgia.—Waycross. A complete system of water-works is to be constructed, and the necessary pumps and other machinery will soon be purchased.——Cedartown. Plans and specifications for a system of water-works are being prepared by L. J. Wagner, of Rome, Ga.——Marietta. The Jeter & Boardman Water and Gas Association of Macon, Ga., have made a proposition to build water-works.——Acworth, Cobb Co. The question of establishing water-works is now being agitated.

Virginia.—Clifton Forge. W. C. Moody can give information in regard to the question of water-works now being agitated.

Syracuse, N. Y.—A suit of ejectment temporarily restraining the Syracuse Water Co. from operating the 32 gang wells or machinery, which they have established in the Onondaga valley has been bought by the buyers of this land, and was signed by Justice Williams, of Syracuse, Sept. 24. The plaintiffs claim that the company has without authority, or even the approval of the Common Council of Syracuse, entered upon the premises, dug and torn up the soil, caused a continual nuisance and irreparable injury, for which the plaintiffs have no adequate redress at law. On the other hand, Martin A. Knapp, Counsel for the water company, states that the company has legitimate possession and proposes to retain it.

Canals.—Dakota wants a canal 100 ft. wide, 20 ft. deep and 480 miles long, from a point on the Missouri river in Flannery county to a point on the James river in Stutsman county. It is to cost $20,000,000, throw open more than 1,500 miles to navigation through a fertile region, and furnish irrigation to 30,000,000 acres of land now too arid to be of practical use for farming purposes.——Work on the great canal near Folsom City, Cal., is progressing rapidly. The foundation for the dam has been completed.——The Cosumnes Land and Water Company, of which H. G. Smith is President and Cyrus Wheeler, Secretary, are building a fourteen-mile irrigation canal from Michigan Bar to Whitaker & Ray's tract, northeast of Galt, Cal. The canal will carry about 2,000 ins. of water and will be completed February 1, 1889.——At Villa Lerdo, Mexico, work has been begun on a canal to conduct water to Tiahuilalo. Several thousand men are employed, and 10 steam dredges are now *en route* from England. The length of the canal will be over 60 miles and it will be finished in six months. The canal will open up a rich cotton belt to the company constructing it.

Brookline, Mass.—The report of the Water Board for the year ending Jan. 1, 1888, shows that while the original promoters of the water-works were far-seeing as to the future demand, yet the growth of the town has been more rapid than was expected and a partial supply has to be drawn indirectly from the river. There was trouble from bad smell and taste of the water, owing to the vegetable growth in the reservoirs; the high service tank was covered over as an experiment and this proved successful. During the year there were laid 951 ft. of 10-in. pipe, 820 ft. 8-in., 4,095 ft. of 6-in. and 1,178 ft. of 2-in.; there were also added 112 service pipes. There are now 30 miles, 1,824 ft, of 1 to 16-in. pipe on the low service system, and 8 miles, 485 ft. of 2 to 12-in. pipe on the high service system; total, 38 miles, 2,279 ft. Also 56 meters. The pumping at the low-service pumping station was 282,513,637 galls.; and at the high-service pumping station, 28,138,291 galls. F. F. Forbes is Superintendent.

A Foster Automatic Pressure Regulator has been ordered by the Cincinnati Water Department from I. M. FOSTER, of 242 Water St., New York, under date of Sept. 21; it was of the 10-in. standard-size.

Portland, Ore.—In the report of the Fire Commissioners for 1887, it is stated that the commissioners place hydrants on the mains laid by the Water Commission. The former state as follows: "We have so placed 21 new hydrants, but on account of the great distance have been obliged to place them at greater intervals than we wished. We may not have the resources to keep up with the Water Committee in the future, as their work in this particular will hereafter in all probability be on such an extended scale that it may eventually of necessity become a part of their duty to place hydrants." There are in all 123 hydrants, 71 being on the mains of the city water-works. During the year 4.06 miles of new and larger mains were laid, and connected with the cisterns from which water is drawn for fire purposes.

Phœnixville, Pa.—The Superintendent, Mr. A. S. VANDERSLICE, has submitted to the Borough Council his report of the management of the Water Department for the year ending March 1, 1888, being the fifteenth annual report. After consultation with H. R. Worthington, the builder of the two pumps that are now used at the same time in forcing water through one main to the reservoir, an additional main was recommended. During the year 4,875 ft. of pipe were laid, and 9 hydrants set. There are now 12 miles, 207 ft. of 3 to 18-in. pipe. The total amount of water pumped to the reservoir was 226,919,117 galls.

Springfield, Ill.—The Water Commissioners have presented their report for the year ending Feb. 29, 1888, being the twenty-second annual report. A considerable number of improvements have been made; 15 miles of pipe laid and the fire protection greatly increased. The cost of machinery and buildings has been about $40,000, pipe extension $60,000, and interest paid $19,000; which amounts as well as ordinary expenses, have been met from the receipts of the works. A larger pumping main from the river to the city is recommended, also provision for obtaining a purer water supply, as the angamon river water is sometimes unfit for domestic use; appropriations of $10,000 for each of these purposes, are recommended. The total pumpage of the year was 2,440,780 galls. There are now 29 miles 3,600 ft. of 3-in. to 15-in. pipe, 133 hydrants and 47 meters: also 1,504 connections. PETER BERRIMAN is Superintendent.

Special Reports of Water-Works Construction.

THE ENGINEERING NEWS MANUAL OF AMERICAN WATER-WORKS is now being compiled, and will be *indispensable* to every manufacturer, engineer and contractor in any way interested in Water-Works construction and maintenance, and will be of great value to Water-Works superintendents and projectors of new works.

Superintendents of water-works and water companies will wish to see correct and complete data concerning their Works in our MANUAL, and to ensure this they should send in reports *at once* upon the blanks which we have already sent to every Water-Works office in the United States and Canada. Many have delayed their report, and if the blanks we intended for them have been lost in the mail, or mislaid, we will send more upon request.

We *must* have a report from every public water supply system in North America, so those who reply to our inquiries at once will save a second inquiry. We also wish to know of *every* new Water-Works plant in process of construction, and of *every* new project in this line. We will send to any one desiring them, blanks upon which reports can be made.

Further details of the MANUAL will be advertised later. We abstract from our special reports for the MANUAL the following items of current interest:

ADDISON, N. Y., Sept. 29, 1888.

EDITOR ENGINEERING NEWS:—A system of water-works is now being constructed in this place by a private company, of which E. M. WELLS is President, and H. C. HITCHCOCK, Treasurer. The supply will be obtained from a well, water pumped to a reservoir, from which a hydrant pressure for fire protection will be obtained. The probable cost of the works will be $40,000, and they will be completed about June 1, 1889. Population is 2,500.

H. C. HITCHCOCK, *Treasurer.*

COLTON, Cal., Sept. 20, 1888.

EDITOR ENGINEERING NEWS:—The contracts for putting in water-works, supply to be taken from artesian wells, will be let in about 60 days from this date. The probable cost of the work will be $60,000, which has been secured by a vote for bonds. H. B. BAILEY, City Engineer, is in charge of the surveys. Population 2,000.

W. W. WILCOX.

TUSCARORA, Nev., Sept. 19, 1888.

EDITOR ENGINEERING NEWS:—The Tuscarora Water Co., P. C. HYMAN, President, is now putting in a gravity system of water-works, from which a hydrant pressure sufficient for fire protection will be obtained. The water supply at present is obtained from wells and small springs. The new supply will be from Twin Bridges creek. The capital for construction was raised by subscription. Mr. SCHUSSLER is designing and constructing engineer, and the probable cost of works when completed will be $150,000. Works will be completed about Nov. 1, 1888. Population is 25,000.

H. W. COFFIN, *Superintendent.*

We have received from J. W. WHITHAM, Professor of Engineering, at Fayetteville, Ark., report of the Rogers, Ark., water-works which were begun July 21, and completed Oct. 1, 1888. They were designed and built by P. B. PERKINS, of Springfield, Mo. The supply is taken from a spring of 876,330 galls. capacity, located 2,600 ft. east of the tower. The works are owned by the "Rogers Lime & Water Co. The officers are: J. W. FREY, Prest.; GEO. RAUPT, Sect'y.

In addition to the information given in our issue of Sept. 15, regarding the Ontario, Cal., Water-Works and the plan of distribution, terms between the Land and Water Companies and manner of increasing the supply, we have received the following from F. E. TRASK, Engineer and Superintendent: The present population is 2,000. The water is conducted by gravity from the San Antonio Canon creek and tunnel through 80 miles of cement and cast-iron pipe; wrought-iron is used for the services. The works are owned by the San Antonio Water Co., S. P. HILDRETH, Prest.; W. J. WADDINGHAM, Sec'y. GEORGE CHAFFEY was designing, and F. E. TRASK Constructing Engineer. Work was begun in 1883, and will be completed Jan. 1, 1889. The average daily consumption is 3,000,000 galls., the greater part of which is used for irrigation. Ordinary and fire pressure 150. The amount of capital stock and bonds is $1,500,000. Cost of works $300,000. The annual operating expenses are $2,000. Revenue from consumers is $2,450; from city, $800.

RECORD OF NEW WATER WORKS CONSTRUCTION.

(Specially communicated).

CONTINUED FROM PAGE 258.

Tampa, Fla.—The works were commenced in January, 1888, and they are to be in operation by November. They were designed by A. E. BOARDMAN, who is also Constructing Engineer. The buildings, pumps and boilers, and all foundations are erected, and pipe and all material on the ground. The contract for the works was taken by the Jeter & Boardman Gas & Water Association, of Macon, Ga. The pumping machinery was furnished by H. R. Worthington, of New York; the pipes, specials, valves, hydrants and tank, by R. D. Wood & Co., of Philadelphia, Pa. The water is taken from artesian wells and pumped into an elevated reservoir, consisting of a tank 30 ft. by 21 ft. on top of an iron tower 100 ft. high. There are two duplex, high pressure pumping engines, with a daily capacity of 750,000 galls. each. There are to be 12 miles of pipe and 110 hydrants; the mains are of cast-iron, and the services of galvanized iron. Ordinary pressure, 50 lbs. The cost of the works is estimated at $160,000; debt, $82,600; rate of interest, 6 per cent. The franchise is for 30 years, and the hydrant rental is $45 per hydrant per annum. The works are owned by the Tampa Water-Works Co.; President, J. S. SCHOFIELD; Secretary, W. J. ALLEN; Treasurer, A. E. BOARDMAN. Stock, $100,000: bonds, $82,000. The Superintendent is J. S. WYNNE. The present population is 9,000. (Date of special report: June 15, 1888.)

Woodstock, Vt.—The works were commenced in May, 1887, and completed Dec. 1, 1887. The engineer for the pipe line was J. J. RANDALL, of Rutland, Vt., and T. WM. HARRIS, of New York, was constructing Engineer. The contract for works complete was let to R. D. Wood & Co., of Philadelphia, and sublet to T. Wm. Harris & Co., of New York. The water is taken from springs, and the supply is by gravity from a reservoir with a capacity of 2,500,000 galls. There are about 7 miles of pipe, 20 hydrants and 100 taps; the mains are of cast-iron, and the services of galvanized iron. Ordinary and fire pressure, 110 lbs. Cost of works, $36,000. During the winter the works were at a standstill, and services are now being put in. The hydrant rental is $35 per hydrant per annum. The works are owned by the Woodstock Aqueduct Co.; President, F. K. BILLINGS; Vice President, F. S. MACKENZIE; Secretary, H. C. PHILIPS; Treasurer, F. W. WILDER. Capital stock, $36,000. JAMES W. HAZEN is Superintendent. The population is 1,500. (Date of special report; June 1, 1888).

Jeffersonville, Ind.—The works were commenced in December, 1887, and were to be completed by July, 1888. They were designed by E. F. FULLER, who was also Constructing Engineer. The contractor was Samuel R. Bullock, of New York City. The pumping machinery was furnished by the Holly Mfg. Co., of Lockport, N. Y.; the pipe and specials by Dennis Long & Co., of Louisville, Ky.: the valves and hydrants by the Ludlow Valve Mfg. Co., of Troy, N.Y., and the stand-pipe by Riter & Conley, of Pittsburg, Pa. The source of supply is the Ohio river and the water is pumped to a stand-pipe, 150 ft. high and 15 ft. diameter, by 2 compound, condensing, pumping engines with a daily capacity of 3,000,000 galls. There are 10 miles of pipe and 110 hydrants; the mains are of cast-iron, and the services of wrought-iron and lead. Rate of interest, 6 per cent. Annual revenue from the city, $6,250. The franchise is for 50 years. The works are owned by the Jeffersonville Water Supply Co.; President, E. WOLTMANN; Treasurer, N. P. HOBART; Secretary, C. M. BERRIAN. Stock, $200,000; bonds, $200,000. Superintendent, Geo. C. Stevenson. The present population is 15,000. (Date of special report, Feb. 11, 1888.)

TO BE CONTINUED).